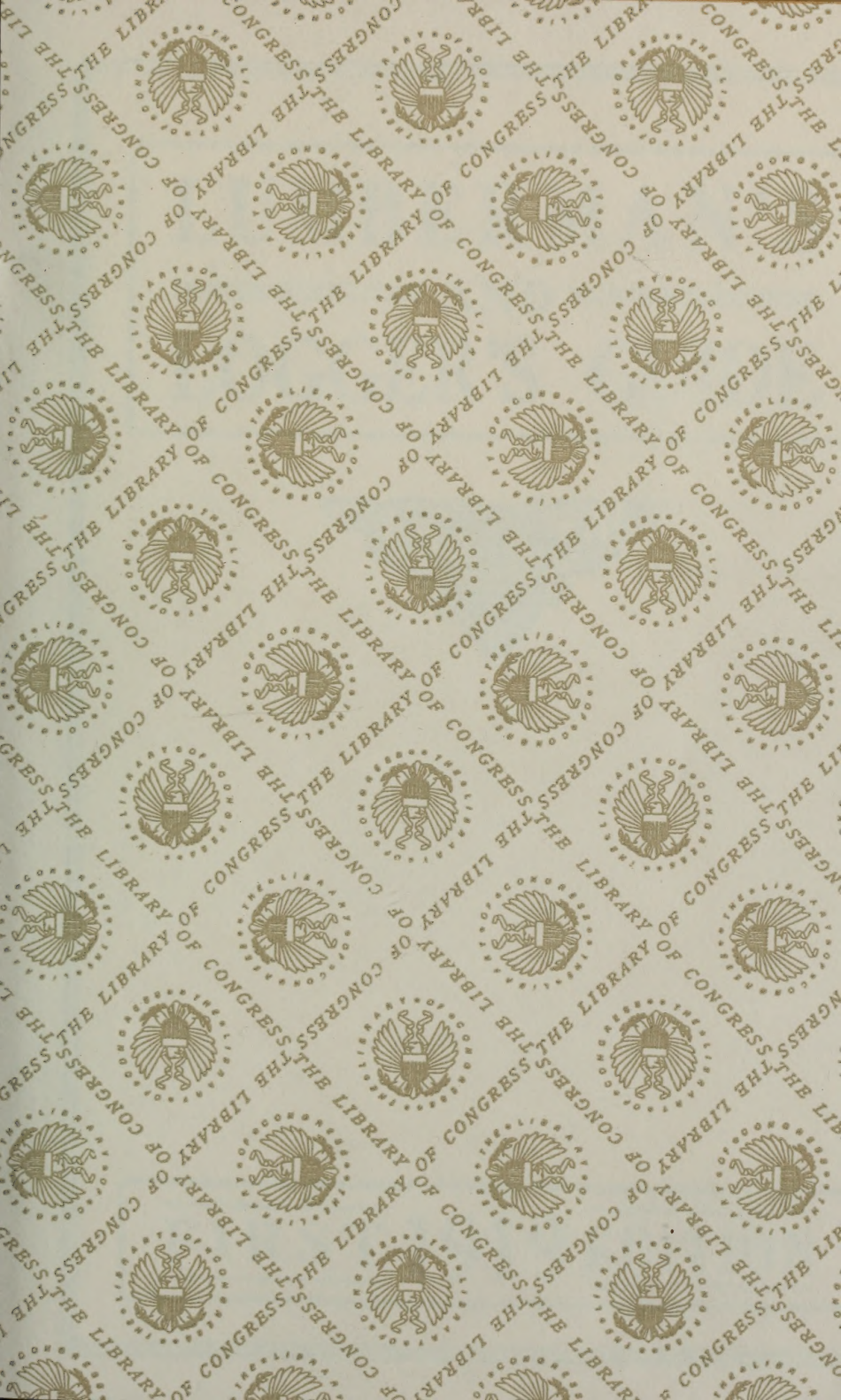


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LUMBERMAN'S
AND
LOGGER'S GUIDE



FIRST 1919 EDITION

Lumberman's and ∴ Logger's Guide ∴

Merits and Uses of
Douglas Fir, California
Redwood *and the* Leading
Commercial Woods of
∴ the Pacific Coast ∴

Rapid Methods of Computing Specifications, Contents
and Weight of Squared and Tapering Lumber
Octagon Spars and Logs

LOG TABLES

Log Scaling and Grading Rules

THE METRIC SYSTEM

Includes Conversion Tables and Information Relative to Foreign
Export Cargo Shipments

TABLE OF DISTANCES

From Pacific Coast Ports to Foreign Ports also Inland Waters of Puget Sound
Columbia River and British Columbia

BERNARD BRERETON

Author and Publisher

P. O. Box 1158

Tacoma, Wash., U. S. A.

PRICE ONE DOLLAR

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PREFACE

The object of the author in presenting this book to the public is to furnish reliable data pertaining to the merits and uses of Douglas Fir, California Redwood and Pacific Coast Forest Products.

The various subjects treated will save the Lumberman and Logger many hours of research, as the numerous problems covered cannot be solved without the practical and technical knowledge that can only be gained by a long and varied experience in both the Lumber and Shipping industries.

As Belgium, France Italy and Countries using the "Metric System" require lumber and specifications to conform to their standard, the writer has specialized on this subject, so as to enable shipowners and lumbermen to successfully cater to this trade, which will increase to vast proportions if the demands of the Foreign buyer are satisfactorily complied with.

Owing to the destruction of Railroads, Bridges, Docks and Buildings of every description in the European Countries, devastated as a result of the "Great war," enormous quantities of lumber and especially long timbers will be required for repair work and permanent constructional purposes.

The eyes of the "World" will naturally turn to the Pacific Coast in quest of information relative to Douglas Fir, California Redwood and the methods of handling these shipments, and to those requiring this knowledge, the Lumberman's and Logger's Guide will furnish the answer.

Shipowners, Captains and officers of vessels, or any one connected with the operation of cargo carriers, will appreciate the information regarding the system for computing the lumber carrying capacity of steamers also the Table of Distances which will enable the reader to ascertain the distance from the leading ports of the World to any Douglas Fir or Redwood Cargo Mill on the Pacific Coast.

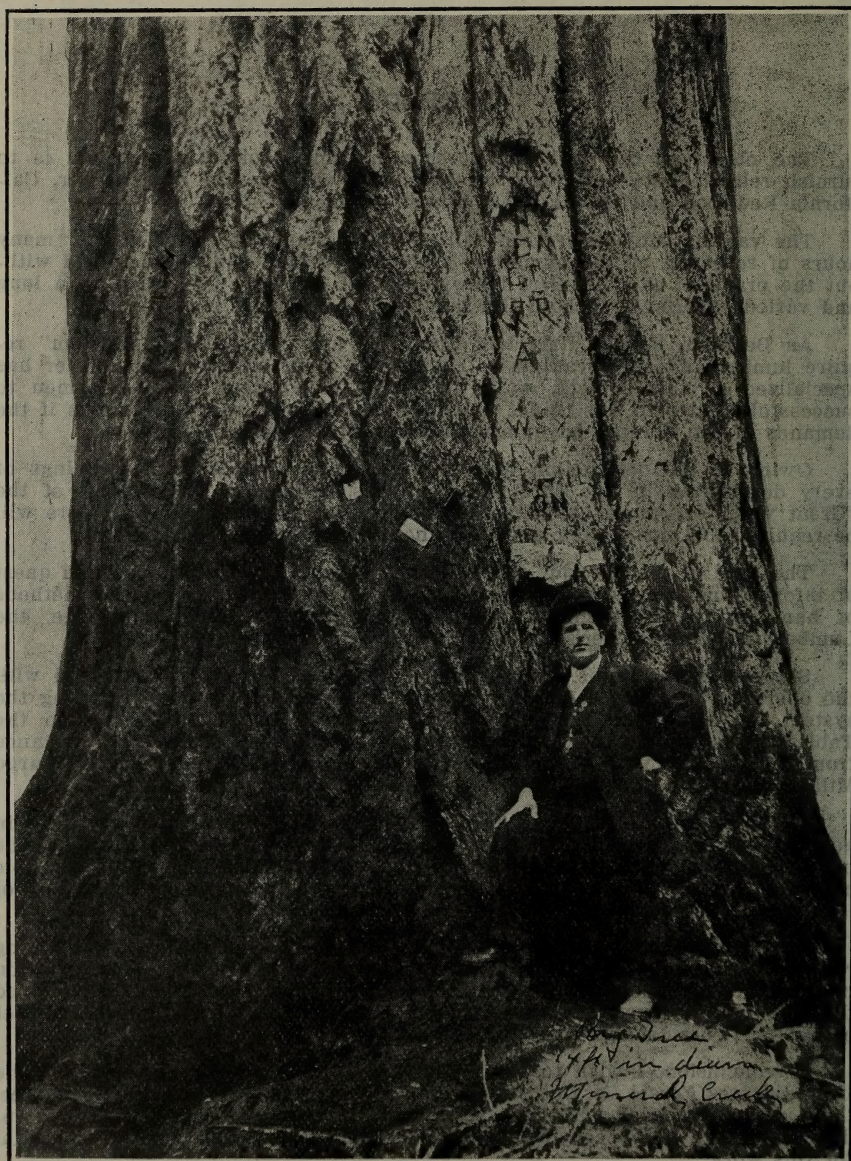
In the section of this book devoted to logs will be found the log tables in general use in British Columbia, Washington, Oregon and California, the methods for computing same, also the log grading rules and a special table computed by the author showing the actual or solid contents in board feet of logs ranging from six to forty-eight inches in diameter.

To the Foreign or prospective lumber buyer who is desirous of obtaining reliable data concerning Douglas Fir or California Redwood, the information in this book can be absolutely relied upon as I have personally supervised the manufacture, inspection or shipment of upwards of fifty million board feet of Pacific Coast Lumber annually for a period of over twenty-five years.

In conclusion, I wish to express my appreciation to the officials of The United States Forest Service, the Bureau of Foreign and Domestic Commerce, the Lumber Trade Journals and my friends in the Lumber and Shipping Industries who have so courteously furnished me with much valuable material for this work.

BERNARD BRERETON,
Author and Publisher.

DOUGLAS FIR
(aMolliat T. apueT)



DOUGLAS FIR

(*Tsuga Taxifolia*)

DOUGLAS FIR

Pseudotsuga Taxifolia

Douglas Fir, widely known as Oregon Pine, reaches its best development for commercial purposes on the Pacific Coast, from the head of the Skeena River, in British Columbia, and southward through the States of Washington and Oregon to Central California.

The wood is comparatively light but very strong; it is the strongest wood in the world for its weight that is obtainable in commercial sizes and quantities.

With the exception of Spruce, Douglas Fir is in greater demand for Airplane construction than any other wood, and material of excellent quality for this purpose can be furnished in unlimited amounts.

THE CORRECT NAME

Douglas Fir is named after David Douglas, botanist, who explored British Columbia (then called New Caledonia) in 1825-30. It is the most important timber tree on the North American Continent, and is known by a great variety of names, such as Oregon Pine, Oregon Fir, Washington Fir, Yellow Fir, Red Fir, Douglas Spruce, Red Spruce, Puget Sound Pine, and British Columbia Pine.

The employment of so large a number of names for one class of tree is very confusing, detrimental and often misleading, and for these reasons the United States Forest Service some years ago took a lumber census which resulted in their adopting the name Douglas Fir, as it was used more than all others combined.

MERITS AND USES

The stand of timber in Oregon and Washington alone, it is estimated, comprises 25% of the remaining stand of timber in the United States, and in British Columbia is estimated to comprise one-third of the total timber supply of Canada. It is considered the strongest softwood in the world. (See United States Forest Service Bulletin No. 108.) Douglas Fir is moderately hard but easy to work, straight grained, resilient, tough and durable.

DOUGLAS FIR

Merits and Uses - Continued

Combining these qualities of great strength, light weight, ease of working and handling more than any other commercial timber, Douglas Fir is the ideal wood for practically all building and structural purposes. Owing to the great size of the trees Douglas Fir timber can be furnished in the largest dimensions required in modern heavy construction. As complying with qualities essential in a wood acceptable for general building purposes, Douglas Fir is practically impervious to water, holds nails firmly, takes stain well in any shade or color, and combines beauty, utility and durability. It is superior wood for bridge and wharf building, heavy joists where great strength is required, studding—in fact, all ordinary framing material, ship plank, ship decking, spars, derricks, car sills, car siding, car roofing, car lining, flooring, ceiling, silo stock, sash and doors, interior finish. The lower grades are also used in large quantities for under-ground mining purposes.

The United States Forest Service Bulletin No. 88, says: "Douglas Fir may, perhaps, be considered the most important of American woods. * * * It is manufactured into every form of lumber known to the saw mill operator. For house construction Douglas Fir is manufactured into all forms of dimension stock, and is used particularly for general building and construction purposes. Its strength and comparative lightness fit it for joists, floor beams, rafters, and other timbers which must carry loads.

"The comparative hardness of the wood fits it for flooring and it meets a large demand. Douglas Fir edge-grain flooring is considered superior to that made from any other softwood.

"Clear lumber, sawed flat grain, shows pleasing figures, and the contrast between the spring and summer wood has been considered as attractive as the grain of quarter-sawn oak. It takes stain well, and by staining, the beauty of the grain may be more strongly brought out and a number of rare woods can be successfully imitated."

The durability of the wood, and the fact that it resists saturation by water cause it to be used in large quantities for wooden piping, for continuous stave and jointed conduits used in power and irrigation works, for silos and tanks. It makes first-class railway ties, whether treated with preservatives or not. Street pavement of creosoted Douglas Fir blocks properly laid is noiseless, dustless, economical in upkeep, and is durable and long wearing even under heavy traffic such as that of freight and dock yards. The unusual valuable combination of qualities possessed by Douglas Fir adapt it to such a variety of uses that a complete list of them would cover nearly all the uses to which wood can be put.

AVERAGE STRENGTH VALUES FOR STRUCTURAL TIMBERS

Taken from U. S. Forest Service Bulletin 108

GREEN

| SPECIES | Cross Section Under Test, Inches. | No. of Tests. | Rings per Inch. | Moisture Content, percent. | Weight, Oven Dry lbs., per cu. ft. | Fiber Stress at Elastic Limit, lbs., per sq. in. | Modulus of Rupture, lbs. per sq. in. | Modulus of Elasticity, 1000 lbs. per sq. in. | Relative Strength Based on Modulus of Rupture, Douglas Fir, 100%. | Relative Stiffness Based on Modulus of Elasticity, Douglas Fir, 100% |
|-----------------|--|---------------|-----------------|----------------------------|------------------------------------|--|--------------------------------------|--|---|--|
| Douglas Fir | 8x16 | 134 | 10.9 | 31.8 | 28.9 | 4282 | 6605 | 1611 | 100.0 | 100.0 |
| Western Hemlock | 8x16 | 27 | 17.6 | 41.9 | 28.1 | 3761 | 5821 | 1489 | 88.1 | 92.4 |
| Long-leaf Pine | 12x12 10x16 8x16 6x16 6x10 | 13 | 14.6 | 29.2 | 35.4 | 3855 | 6437 | 1466 | 97.4 | 91.0 |
| Short-leaf Pine | 8x16 8x14 8x12 | 33 | 12.3 | 48.4 | 31.4 | 3376 | 5948 | 1546 | 90.0 | 96.0 |
| Loblolly Pine | 5x12 8x16 | 78 | 6.2 | 58.0 | 31.2 | 3266 | 5568 | 1467 | 84.4 | 91.1 |
| Western Larch | 8x16 8x12 | 43 | 23.9 | 50.5 | 28.7 | 3677 | 5562 | 1364 | 84.2 | 84.6 |
| Redwood | 8x16 6x12 7x9 | 30 | 19.5 | 90.2 | 23.3 | 4323 | 5327 | 1202 | 80.6 | 74.6 |

NOTE:—Care was taken in selecting Douglas Fir material to secure a large number of stringers of low grade. Douglas Fir contained more knots than its nearest competitor in strength. Even with this handicap it shows greater strength values than other species.

AVERAGE STRENGTH VALUES FOR STRUCTURAL TIMBERS

Established by the U. S. Government

| SPECIES | Green Stringers | | Air-Seasoned Stringers | |
|-----------------|------------------------|---------|------------------------|---------|
| | Breaking Strength Lbs. | Percent | Breaking Strength Lbs. | Percent |
| Douglas Fir | 6605 | 100.0 | 7142 | 100.0 |
| Longleaf Pine | 6437 | 97.4 | 5957 | 83.6 |
| Shortleaf Pine | 5948 | 90.0 | 7033 | 98.5 |
| Western Hemlock | 5821 | 88.1 | 7109 | 99.6 |
| Loblolly Pine | 5568 | 84.4 | 6259 | 87.7 |
| Western Larch | 5562 | 84.2 | 6534 | 91.5 |
| Redwood | 5327 | 80.6 | 4573 | 64.1 |
| Tamarack | 4984 | 75.5 | 5865 | 82.3 |
| Norway Pine | 3767 | 57.0 | 5255 | 73.7 |

Note that Douglas Fir is unequalled in strength by any other species. It is 25 percent. lighter in weight than its nearest competitor in strength.

WEIGHT OF FRESHLY SAWN DOUGLAS FIR

1000 BOARD FEET EQUALS 3333 POUNDS

To quickly ascertain the weight in pounds of "green" Douglas Fir: Add one cipher to the board feet, and divide by 3.

Example: Find the weight in pounds of 672 board feet Douglas Fir.

Process:

672×10 equals 6720, divided by 3 equals 2240 pounds.

3)6720

2240 pounds

The above is a very close estimate for all practical purposes, and has proved correct in thousands of instances.

Lumber for export shipments can be reckoned at the rate of 1,000 board feet to $1\frac{1}{2}$ tons of 2240 pounds.

Example: Find the weight in long tons of 120,000 board feet Douglas Fir.

Operation

$120 \times 1\frac{1}{2}$ equals 180 long tons.

KILN DRIED LUMBER

Kiln dried lumber of one inch in thickness loses about one third of its weight in the process of drying. Weights of kiln dried rough and finished stock can be obtained from any Local Price List or by applying to the West Coast Lumber Manufacturers Association, Seattle, Wash., U. S. A.

METRIC WEIGHT

Weight of Douglas Fir in kilograms and metric tons is given in the Metric Section.

SPECIFIC GRAVITY

The weight of wood is sometimes expressed by a comparison of the weight of a given volume of wood with that of an equal volume of water, or by what is known as "specific gravity." If the specific gravity of a certain kind of wood is stated as .300, it means that a given volume of this wood weighs .300 times as much as an equal volume of water. Since a cubic foot of water weighs 62.5 pounds, or 1000 ounces, a cubic foot of wood of specific gravity of .300 weighs $.300 \times 62.5 = 18.75$ pounds.

A cubic foot of green Douglas Fir whose specific gravity is .640, weighs $.640 \times 62.5 = 40$ pounds per cubic foot. Hence the weight per cubic foot of any kind of wood can be quickly ascertained when the specific gravity is known.

The specific gravity of a body or substance divided by 16 will give the weight of a cubic foot of it in pounds.

Example: The specific gravity of a cubic foot of green Douglas Fir is .640; what is the weight of it?

Process:

.640 divided by 16 equals 40, the weight of a cubic foot in pounds.

When the weight of a cubic foot of lumber is known, the specific gravity can be ascertained by multiplying the number of pounds by 16.

Example: Find the specific gravity of Dry Redwood weighing 26 pounds per cubic foot.

Process:

26×16 equals 416, the specific gravity.

LATH

The standard for California and West Coast of South America is $\frac{1}{3} \times 1\frac{1}{2}$ in.—4 ft., tied in bundles of 100 pieces.

The Australian standard is as follows:

$\frac{1}{3} \times 1$ in.— $4\frac{1}{2}$ ft., tied in bundles of 90 pieces.

$\frac{1}{3} \times 1\frac{1}{4}$ in.— $4\frac{1}{2}$ ft., tied in bundles of 90 pieces.

$\frac{1}{3} \times 1\frac{1}{2}$ in.— $4\frac{1}{2}$ ft., tied in bundles of 90 pieces

MEASUREMENTS, CONTENTS AND WEIGHTS

$\frac{1}{3} \times 1\frac{1}{2}$ in.—4 ft.—

1000 Pcs. contain $166\frac{2}{3}$ ft. B. M.

6000 Pcs. equal 1000 ft. B. M.

1000 Pcs. Kiln Dried, weigh 500 lbs.

1000 Pcs. Green, weigh 700 lbs.

$\frac{1}{3} \times 1$ in.— $4\frac{1}{2}$ ft.—

1000 Pcs. contain 125 ft. B. M.

8000 Pcs. equal 1000 ft. B. M.

1000 Pcs. Kiln Dried, weigh 375 lbs.

1000 Pcs. Green, weigh 530 lbs.

$\frac{1}{3} \times 1\frac{1}{4}$ in.— $4\frac{1}{2}$ ft.—

1000 Pcs. contain $156\frac{1}{4}$ ft. B. M.

6400 Pcs. equal 1000 ft. B. M.

1000 Pcs. Kiln Dried, weigh 470 lbs.

1000 Pcs. Green, weigh 660 lbs.

$\frac{1}{3} \times 1\frac{1}{2}$ in.— $4\frac{1}{2}$ ft.—and

$\frac{3}{8} \times 1\frac{1}{2}$ in.—4 ft.

1000 Pcs. contain $187\frac{1}{2}$ ft. B. M.

5333 Pcs. equal 1000 ft. B. M.

1000 Pcs. Kiln Dried, weigh 560 lbs.

1000 Pcs. Green, weigh 800 lbs.

When lath are made $\frac{3}{8}$ of an inch in thickness, the contents and weight can be computed by adding to the measurements given in the preceding table $\frac{1}{8}$ of the corresponding amount.

1000 Pcs. $\frac{1}{3} \times 1\frac{1}{2}$ —4 ft. lath will cover 70 yards of surface.

FREIGHT

When figuring lath of any of the foregoing sizes and length for cargo freight, the prevailing custom formerly was to reckon six pieces as being the equivalent of one foot board measure, but the correct way is to figure them at actual contents.

TO FIND THE NUMBER OF $\frac{1}{2}$ -IN.X4-FT. LATH REQUIRED FOR A ROOM

Find the number of square yards in the walls and ceiling and multiply by 16, the number estimated to a square yard. The result will be the number of lath necessary to cover the room.

At 16 lath to the square yard, 1,000 lath will cover 63 yards of surface, and 11 pounds of lath nails will nail them on.

STAVES

ACCORDING TO EXPORT "H" LIST

No. 1 Staves 1×4 in. x 4 ft. Sawn full size clear. If seasoned will allow $\frac{1}{8}$ of an inch scant in width.

No. 2 Staves 1×3 in. x 4 ft. Will allow variations in size of $\frac{1}{8}$ of an inch in thickness and $\frac{1}{8}$ of an inch in width. Sap and two sound hard knots not over $\frac{3}{4}$ of an inch in diameter allowed.

Weight same as pickets. See page 10.

PICKETS ROUGH

The standard size, 1x3—4 feet and 4 feet 6 inches long, are tied in bundles of 10 pieces each; they are in great demand for the Australian market, and are used for fences, and occasionally are sawn into inch lath; they are also extensively utilized as staves for mutton-tallow barrels.

GRADE ACCORDING TO EXPORT "H" LIST

Pickets 1x3 in.—4 ft.—4 ft. 6 in.—5 ft. Will allow variations in size of $\frac{1}{8}$ of an inch in thickness and $\frac{1}{8}$ of an inch in width. Sap, pitch pockets, and two sound hard knots not over 1 inch in diameter allowed.

MANUFACTURE

Strict attention should be paid to their manufacture, and it is essential that they be uniform in thickness. They can be made from air or kiln dried stock and many mills rip 2x3 to $1\frac{5}{16}$ of an inch to make them.

In most cases pickets are subject to rigid inspection, and it is useless to make them from anything but the best material.

DISCOLORATION

Unless there are prospects of shipping pickets within a short time after they are manufactured, they should be piled on their edge in bundles, and crossed in alternate courses with an air space between each bundle of about 4 inches. This prevents discoloration, and is the method employed by a number of mills who aim to ship their stock in a satisfactory condition.

MEASUREMENT, CONTENTS AND WEIGHT

1000 pcs. 1x3—4 feet contain 1000 feet Board Measure, and average 3500 lbs. in weight.

1000 pcs. 1x3—4 $\frac{1}{2}$ feet contain 1125 feet Board Measure, and average 4000 lbs. in weight.

The above weight is for green stock; when seasoned lumber is used, due allowance must be made for difference in material.

CORD MEASURE

Firewood, small pulp wood, and material cut into short sticks for excelsior, etc., is usually measured by the cord. A cord is 128 cubic feet of stacked wood. The wood is usually cut into 4-foot lengths, in which case a cord is a stack 4 feet high and wide, and 8 feet long. Sometimes, however, pulp wood is cut 5 feet long, and a stack of it 4 feet high, 5 feet wide and 8 feet long is considered 1 cord. In this case the cord contains 160 cubic feet of stacked wood. Where firewood is cut in 5-foot lengths a cord is a stack 4 feet high and 6 $\frac{1}{2}$ feet long, and contains 130 cubic feet of stacked wood. Where it is desirable to use shorter lengths for special purposes, the sticks are often cut 1 $\frac{1}{2}$, 2, or 3 feet long. A stack of such wood, 4 feet high and 8 feet long, is considered 1 cord, but the price is always made to conform to the shortness of the measure.

A cord foot is one-eighth of a cord and equivalent to a stack of 4-foot wood 4 feet high and 1 foot wide. Farmers frequently speak of a foot of cord wood, meaning a cord foot. By the expression "surface foot" is meant the number of square feet measured on the side of a stack.

In some localities, particularly in New England, cord wood is measured by means of calipers. Instead of stacking the wood and computing the cords in the ordinary way, the average diameter of each log is determined with calipers and the number of cords obtained by consulting a table which gives the amount of wood in logs of different diameters and lengths.

RELATION BETWEEN BOARD MEASURE, CUBIC MEASURE AND CORD MEASURE

In order to determine the number of feet in a standard cord of stacked wood (4 feet x 4 feet x 8 feet), and also to ascertain the number of solid cubic feet of wood in a cord, the class in forest mensuration of the Montana Forest School has just completed a study on this phase of the subject. A number of 16-foot softwood logs (Douglas fir, western larch and western yellow pine), averaging about 12 inches in diameter at the small end, were first scaled with Scribner Decimal "C" Rule. The logs were next cut into 4-foot lengths and the number of cubic feet in each piece accurately determined. The 4-foot lengths were next split into the usually convenient cordwood stick and stacked into a pile 4 feet high and 8 feet long. The following were the results obtained:

A standard cord (128 cubic feet) of stacked wood (Douglas fir, western larch, western yellow pine) contains:

517 board feet (Scribner Dec. "C" Scale).

963 board feet (62.7 percent) of actual wood.

80.25 cubic feet of actual wood.

37.3 percent of a stacked cord is air space.

A similar study carried out by the forestry students of the University of Wisconsin (1914), in the university oak woodlot near Madison, Wis., gave 73 cubic feet (57 percent) of actual wood per cord. This was nearly all red and black oak, and the 73 cubic feet represented the average for 23 cords of wood, used by the university as fuel.—R. R. Fenska, acting dean, University of Montana, Missoula, Mont.

It is generally agreed that the conifers pile closer in cordwood than do the hardwoods and this explains the difference in the two sets of university figures referred to in the foregoing.

METRICAL EQUIVALENT

1 Stere (Cubic Meter) equals 0.2759 of a cord.

1 Cord equals 3.624 Steres.

Note: 1 Stere or cubic meter equals 35.314 cubic feet.

AMOUNT OF PULP WOOD IN A CORD

A cord of wood ordinarily yields about one ton of mechanical pulp or about one-half ton of chemical pulp.

AMOUNT OF HEMLOCK BARK FOR TANNING PURPOSES IN A CORD

Although the cord is used as a standard of measure for bark, it is usually sold by weight in order to avoid variation due to loose piling.

Throughout the East 2,240 pounds are usually called a cord, although in some places 2,000 pounds are accepted.

A long cord of 2,240 pounds equals about 77 cubic feet, a short cord of 2,000 pounds equals about 66½ cubic feet.

It is highly important to keep Hemlock bark intended for tanning purposes well protected from the rain, for it leaches out easily and is soon ruined. For the same reason bark from logs which have been towed or driven is of little value.

Salt water ruins it entirely.

HOW WOOD PULP IS MADE

Wood pulp is usually made by either one or two general processes, mechanical or chemical. In the mechanical process the wood, after being cut into suitable sizes and barked, is held against revolving grindstones in a stream of water and thus reduced to pulp. In the chemical process the barked wood is reduced to chips and cooked in large digesters with chemicals which destroy the cementing material of the fibers and leave practically pure cellulose. This is then washed and screened to render it suitable for paper-making. The chemicals ordinarily used are either bi-sulphite of lime or caustic soda. A little over half of the pulp manufactured is made by the soda process. Much of the mechanical pulp, or ground wood as it is commonly called, is used in the making of newspaper. It is never used alone in making white paper, but always mixed with some sulphite fiber to give the paper strength. A cord of wood ordinarily yields about one ton of mechanical pulp or about one-half ton of chemical pulp.

BURNED OVER TIMBER FOR PULPWOOD

It is a common error to regard burned over timber as being suitable for the manufacture of wood pulp. Young green timber gives the best results for this class of work, as dead wood breaks up when put through the process of manufacture. There is also a great waste on account of the charred surface of some parts of the timber, none of which must get into the pulp. If this should occur the whole batch would be valueless.

HOW TO FIGURE LUMBER

BOARD MEASURE

Lumber is usually reckoned by Board Measures, the unit being a square foot one inch thick.

Lumber less than one inch thick is usually figured as of one inch.

The ordinary way of finding the contents of squared lumber is to multiply together the length in feet, the width and thickness in inches and divide the product by 12.

Figuring lumber by the above rule is a slow process, and the following system is adopted by experts whose business makes rapid calculation essential to their success.

Multiply together the thickness and width in inches, divide the product by 12 and multiply result by the length; the answer is Board Measure contents.

EXAMPLES

A few examples will show the system for finding the contents of standard sizes in a few seconds, and many of them without a moment's hesitation.

Example: Find the Board Measure contents of the following sizes:

| Pcs. | Size. | Length. | B.M. |
|------|--------------|---------|------|
| 1 | 2x 8 inches | 30 feet | 40 |
| 1 | 4x10 inches | 18 feet | 60 |
| 1 | 10x10 inches | 36 feet | 300 |
| 1 | 20x20 inches | 60 feet | 2000 |

Operation

2x8 equals 16 divided by 12 equals $1\frac{4}{3}$ or $1\frac{1}{3}$. When this is multiplied by the length the answer is 40 feet; in other words, add one-third to the length and you have the Board Measure contents.

Operation

4x10 equals 40 divided by 12 equals $3\frac{1}{3}$ or $10\frac{1}{3}$. In this instance a cipher is added to the length and when this is divided by three the result is 60 feet Board Measure contents.

10x10 equals 100; this divided by 12 equals $8\frac{1}{3}$, or $100\frac{1}{12}$. It is easier to multiply by 100 and divide by 12 than to multiply by $8\frac{1}{3}$, therefore add two ciphers to the length and divide by 12; the result is 300 feet Board Measure contents.

20x20 equals 400, divided by 12 equals $33\frac{1}{3}$, or $100\frac{1}{3}$. All that is necessary is to add two ciphers to the length and divide by 3; the result is 2000 feet, Board Measure contents.

After a short reflection on the above method, it will be apparent to everyone that when this system is used I have made good my statement that the contents of any ordinary stick of lumber can be figured inside of a few seconds.

The following standard sizes and multiples for same will serve as a basis for practice, and when memorized will benefit those who wish to become rapid in figuring lumber, and at the same time may prove a stepping stone to a better position and successful career.

STANDARD SIZES AND MULTIPLES

- 1 x 3 Divide lineal feet by 4.
- 1 x 4 Divide lineal feet by 3.
- 1 x 6 Divide lineal feet by 2.
- 1 x 8 Multiply lineal feet by 2 and divide by 3.
- 1 x10 Multiply lineal feet by 10 and divide by 12.
- 1 x12 Lineal feet and Board Measure the same.
- 2 x 3 Divide lineal feet by 2.
- 2 x 4 Multiply lineal feet by 2 and divide by 3.
- 2 x 8 Add to lineal feet $\frac{1}{3}$ of amount.
- 2 x10 Multiply lineal feet by 10 and divide by 6.
- 2 x12 Multiply lineal feet by 2.
- 3 x 3 Multiply lineal feet by 3 and divide by 4.
- 3 x 4 Lineal feet and Board Measure the same.
- 3 x 6 Add to lineal feet $\frac{1}{2}$ the amount.
- 3 x 8 Multiply lineal feet by 2.
- 3 x10 Multiply lineal feet by 10 and divide by 4.
- 3 x12 Multiply lineal feet by 3.
- 4 x 4 Add to lineal feet $\frac{1}{3}$ of amount.
- 4 x 6 Multiply lineal feet by 2.
- 4 x 8 Multiply lineal feet by 3 and subtract $\frac{1}{3}$ lineal feet from amount.
- 4 x10 Multiply lineal feet by 10 and divide by 3.
- 4 x12 Multiply lineal feet by 4.
- 8 x 8 Multiply lineal feet by $5\frac{1}{3}$.
- 10x10 Multiply lineal feet by 100 and divide by 12.
- 12x12 Multiply lineal feet by 12.
- 14x14 Multiply lineal feet by $16\frac{1}{3}$.
- 16x16 Multiply lineal feet by $21\frac{1}{3}$.
- 18x18 Multiply lineal feet by 27.
- 20x20 Multiply lineal feet by 100 and divide by 3.
- 22x22 Multiply lineal feet by $40\frac{1}{3}$.
- 24x24 Multiply lineal feet by 48.

ANOTHER METHOD

A handy method for computing Board Measure contents, preferred by a number of lumbermen, is as follows:

- For all 12 ft. lengths, multiply width by thickness.
- For all 14 ft. lengths, multiply width by thickness, and add $\frac{1}{4}$.
- For all 16 ft. lengths, multiply width by thickness, and add $\frac{1}{3}$.
- For all 18 ft. lengths, multiply width by thickness, and add $\frac{1}{2}$.
- For all 20 ft. lengths, multiply width by thickness, and add $\frac{2}{3}$.
- For all 22 ft. lengths, multiply width by thickness, and add $\frac{3}{4}$.
- For all 24 ft. lengths, multiply width by thickness, and double.

Some objection may be taken to the use of $\frac{2}{3}$ and $\frac{3}{4}$, but often by transposition you can substitute $\frac{1}{4}$, $\frac{1}{3}$, or $\frac{1}{2}$, as in the following:

Examples:

10 pcs. 1x18—22 changed to 10 pcs. 1x22—18.

16 pcs. 1x22—20 changed to 20 pcs. 1x22—16.

In the first example, instead of multiplying 10x18 and adding $\frac{5}{6}$ to the result, multiply 10x22 and add one-half to the result, which will give 330 ft. Board Measure. In the second item, instead of multiplying 16x22 and adding $\frac{2}{3}$, multiply 20x22 and add $\frac{1}{3}$, which gives 586 $\frac{2}{3}$ ft. Board Measure.

The above system is very handy, when figuring lumber from 12 to 24 feet in length, and also where odd widths and thicknesses frequently occur.

MULTIPLICATION

In computing contents of lumber it is often necessary to multiply by the figures from 13 to 19. A simple process is to multiply by the unit of the multiplier, set down the product under, and one place to the right of, and then add to the multiplicand.

Example: Multiply 238 by 15.

238
1190

3570 Answer

To multiply any number by 101 to 109.

Example: Multiply 24356 by 103.

24356
73068

2508668 Answer

Multiply by the unit of the multiplier, placing the product two figures to the right as in above example.

To multiply by 21-31-41-51-61-71-81-91.

Set the product by the tens under the multiplicand in proper position and add, thus:

Example: Multiply 76432 by 61.

Operation:

76432x61
458592
4662352

If ciphers occur between the two digits of the multiplier, the same method can be used by placing the figures in the correct position, thus:

Example: Multiply 76432 by 6001.

Operation:

76432x6001
458592
458668432

FRACTIONAL SIZES

To find the Board Measure contents of lumber $1\frac{1}{4}$ and $1\frac{1}{2}$ inches in thickness, proceed as if the lumber were of one inch and to the amount obtained add one-quarter or one-half, as the case may be.

To bring the lineal feet of fractional lumber to board measure when your time is limited, and you are not familiar with the correct multiple, multiply the lineal feet by the thickness, width and length and divide result by twelve.

ADDITION OF FRACTIONS

Find the sum of $\frac{3}{8}$ and $\frac{5}{13}$

39 40
— —
3 + 5 = 79
— —
8 13 104 Answer

Explanation: Multiply the denominator (8) of the first fraction by the numerator (5) of the second fraction, which gives 40. Next multiply the numerator (3) of the first fraction by the denominator (13) of the second fraction, which gives 39. Now unite these products ($40+39=79$), which gives the numerator of the answer. The denominator of the answer is the product of the denominators ($8\times 13=104$).

MULTIPLICATION OF FRACTIONS

When both the whole numbers are the same, and the sum of the fractions is a unit.

Examples:

$$\begin{array}{ll} \text{Multiply } 4\frac{1}{2} \times 4\frac{1}{2} & \text{Answer } 20\frac{1}{4} \\ \text{Multiply } 7\frac{2}{3} \times 7\frac{2}{3} & \text{Answer } 56\frac{16}{64} \\ \text{Multiply } 9\frac{1}{3} \times 9\frac{1}{3} & \text{Answer } 90\frac{2}{9} \end{array}$$

Operation:

$$\begin{array}{l} 4 \times 4 + 4 = 20 + \frac{1}{2} \times \frac{1}{2} = 20\frac{1}{4} \\ 7 \times 7 + 7 = 56 + \frac{2}{3} \times \frac{2}{3} = 56\frac{16}{64} \\ 9 \times 9 + 9 = 90 + \frac{1}{3} \times \frac{1}{3} = 90\frac{2}{9} \end{array}$$

When the whole numbers are alike and the fractions are one-half, such as $1\frac{1}{2} \times 1\frac{1}{2}$, $2\frac{1}{2} \times 2\frac{1}{2}$, $12\frac{1}{2} \times 12\frac{1}{2}$, add one to one of the whole numbers, then multiply the whole numbers together and to the result add the multiplication of the halves, which always equals one-quarter.

The following examples are self-explanatory:

As Common Fractions:

$$\begin{array}{llll} 1\frac{1}{2} \times 1\frac{1}{2} \text{ equals } 1 \times 2 \text{ plus } \frac{1}{4} \text{ or } 2\frac{1}{4} & \text{Answer} \\ 2\frac{1}{2} \times 2\frac{1}{2} \text{ equals } 2 \times 3 \text{ plus } \frac{1}{4} \text{ or } 6\frac{1}{4} & \text{Answer.} \\ 3\frac{1}{2} \times 3\frac{1}{2} \text{ equals } 3 \times 4 \text{ plus } \frac{1}{4} \text{ or } 12\frac{1}{4} & \text{Answer.} \\ 12\frac{1}{2} \times 12\frac{1}{2} \text{ equals } 12 \times 13 \text{ plus } \frac{1}{4} \text{ or } 156\frac{1}{4} & \text{Answer.} \\ 109\frac{1}{2} \times 109\frac{1}{2} \text{ equals } 109 \times 110 \text{ plus } \frac{1}{4} \text{ or } 11990\frac{1}{4} & \text{Answer.} \end{array}$$

AS DECIMAL FRACTIONS

$$\begin{array}{llll} 1.5 \times 1.5 \text{ equals } 1 \times 2 \text{ plus } 25/100 \text{ or } 2.25 \\ 2.5 \times 2.5 \text{ equals } 2 \times 3 \text{ plus } 25/100 \text{ or } 6.25 \\ 3.5 \times 3.5 \text{ equals } 3 \times 4 \text{ plus } 25/100 \text{ or } 12.25 \\ 12.5 \times 12.5 \text{ equals } 12 \times 13 \text{ plus } 25/100 \text{ or } 156.25 \\ 109.5 \times 109.5 \text{ equals } 109 \times 110 \text{ plus } 25/100 \text{ or } 11990.25 \end{array}$$

MULTIPLICATION OF MIXED NUMBERS

Multiply $46\frac{2}{3}$ by $21\frac{7}{8}$.

Operation:

$$\begin{array}{r} 322) 46\frac{2}{3} \\ 42) 21\frac{7}{8} \\ \hline 966.14 \\ 40.6 \\ 14.0 \\ \hline 102020\frac{2}{4} \end{array}$$

Explanation: Find the product of the whole numbers (966) and to the right put down the product of the numerators of the fractions ($2 \times 7 = 14$). Now multiply the numerator (7) of the lower fraction by the upper whole number (46), which gives 322. Write this on the left of the upper number. Now divide the product thus obtained by the denominator (8) of the lower fraction, which gives 40 and a remainder of 2. Write the 40 in the whole number column and the remainder (2) we multiply by the upper denominator (3), which gives a product of 6 and is written under 14 in the fraction column.

Now multiply the lower whole number (21) by the numerator (2) of the upper fraction, which gives 42. Write it on the left. Now divide 42 by the denominator (3) of the upper fraction, which gives 14 and no remainder. Write a cipher in the fraction column. Now add the partial product and the product is complete. In cases where the partial products of the fractions amount to more than 1, carry the excess to the whole numbers.

DIVISION OF MIXED NUMBERS

Divide $46\frac{5}{8}$ by 7.

Operation:

$$\begin{array}{r} 7 \overline{) 46\frac{5}{8}} \\ \underline{63\frac{7}{66}} \end{array}$$

Explanation: In cases where the divisor is a whole number, the foregoing example does away with the usual method of reducing dividend and divisor to the same denomination.

Proceed as follows: 7 is contained 6 times in 46, with a remainder of 4. Write down 6 to produce the fraction of the quotient we multiply the remainder (4) by the denominator (8), which gives 32; to this is added the numerator (5) and we have the 37, the numerator of the quotient.

The product of the divisor by the denominator is the denominator (56) of the answer.

SHORT RULES

3-inch Plank: One-half the width multiplied by half the length, gives the Board Measure contents.

12-foot Lengths: The Board Measure contents of any piece of lumber 12 feet long is equal to the thickness and width multiplied together.

Lumber 6 inches in Thickness: Half the width multiplied by the length gives the Board Measure contents.

To find Board Measure contents of 4×8 in. multiply lineal feet by 2 and add one-third to the product.

Example: How many feet board measure are there in a piece of 4×8 -in. 30 feet long?

Operation:

$$\begin{array}{r} \text{Multiplied by } 30 \\ \hline 60 \\ \frac{1}{3} \text{ of } 60 = 20 \\ \hline 80 \text{ ft. B. M. Answer.} \end{array}$$

To find board measure contents of 8×8 in. divide lineal feet by 2, add one cipher to the result and to this amount add one-third of the lineal feet. This system requires no mental effort in even lengths up to 26 feet long.

Example: Find board measure contents of 1 piece 8×8 in.—18 and 26 ft. long respectively.

Operation:

$$\begin{array}{l} 18 \text{ divided by } 2 \text{ equals } 9. \\ 18 \text{ divided by } 3 \text{ equals } 6. \end{array}$$

Place the 6 to the right of 9 and you have the answer, 96 ft. B. M.

$$26 \text{ divided by } 2 \text{ equals } 13.$$

$$26 \text{ divided by } 3 \text{ equals } 8\frac{2}{3}.$$

Place the $8\frac{2}{3}$ to the right of 13 and you have the answer, $138\frac{2}{3}$ ft. B. M.

To Convert Board Measure to Lineal Feet, simply reverse the multiple used to bring lineal feet to Board Measure; in other words, multiply Board feet by 12 and divide by thickness and width.

Example: How many lineal feet are there in 1000 feet Board Measure of 2x8?

Process:

$$\begin{array}{r} 1000 \\ 12 \\ \hline 2) \ 12000 \\ \hline 8) \ 6000 \\ \hline \end{array}$$

750 lineal feet.. Answer.

Car orders frequently call for a specified amount of sizes containing special lengths. Before proceeding to load, it is necessary to find the number of pieces required.

Find the number of pieces in the following order:

1000 ft. B. M. 2x4-14.
1000 ft. B. M. 2x4-16.
1000 ft. B. M. 2x4-20.

Bring the Board Measure to lineal feet as shown in previous example, then divide the length into lineal feet. The result will be the number of pieces.

Process:

$$\begin{array}{r} 1000 \\ 12 \\ \hline 2) \ 12000 \\ \hline 4) \ 6000 \\ \hline \end{array}$$

1500 lineal feet.

The lineal feet given is now divided by the respective lengths and the following answer is obtained:

| | |
|----------------------------|----------------------|
| 107 Pcs. 2x4—14 containing | 998 ft. 8 in. B. M. |
| 94 Pcs. 2x4—16 containing | 1002 ft. 8 in. B. M. |
| 75 Pcs. 2x4—20 containing | 1000 ft. B. M. |
| 276 | 3001 ft. 4 in. B. M. |

FIGURING
SQUARE
TIMBERS

This method of computing the Board Measure contents of square or rectangular timbers that exceed 12 inches one or both ways, is known to but very few, if any, lumbermen. It is a rapid way of figuring the majority of sizes, and on account of its simplicity the system is easily committed to memory.

FIGURING
RECTANGULAR
TIMBERS

Rule: Multiply length by width, and to the result add one-twelfth of the thickness for each inch that exceeds twelve.

Example: Find the Board Measure contents of a timber 13-in x 17-in.—48 feet long.

Operation:

$$\begin{array}{r}
 48 \\
 336 \\
 \hline
 48 \text{ multiplied by } 17 \text{ equals } 816 \\
 816 \text{ divided by } 12 \text{ equals } 68
 \end{array}$$

844 Ans. in B. M. Contents.

Explanation: Multiply the length (48 ft.) by the width (17in.), which equals 816. Now as the thickness (13) exceeds 12 inches by one inch, consider this as one-twelfth, which is divided into 816 and equals 68. This amount is added to the 816 and the result is 884 ft. Board Measure contents.

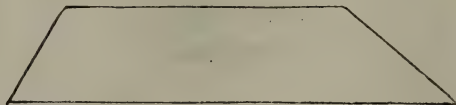
The following multiples will be of assistance to those who wish to practice this system of finding Board Measure contents of timbers by the preceding rule.

- 12x13 Multiply length by 13
- 13x14 Multiply length by 14 and add $\frac{1}{12}$ of result
- 14x14 Multiply length by 14 and add $\frac{1}{6}$ of result
- 14x15 Multiply length by 15 and add $\frac{1}{6}$ of result
- 15x15 Multiply length by 15 and add $\frac{1}{4}$ of result
- 15x16 Multiply length by 16 and add $\frac{1}{4}$ of result
- 16x16 Multiply length by 16 and add $\frac{1}{3}$ of result
- 16x17 Multiply length by 17 and add $\frac{1}{6}$ of result
- 16x18 Multiply length by 18 and add $\frac{1}{3}$ of result
- 18x18 Multiply length by 18 and add $\frac{1}{2}$ of result
- 24x24 Multiply length by 24 and 2
- 26x26 Multiply length by 26 and $2\frac{1}{6}$
- 28x28 Multiply length by 28 and $2\frac{1}{3}$
- 30x30 Multiply length by 30 and $2\frac{1}{2}$
- 36x36 Multiply length by 36 and 3

TAPERING LUMBER

How to Figure Trapezoids, or Boards With Only Two Parallel Sides

Find the Board Measure contents of a board one inch thick, whose parallel sides are 16 feet and 20 feet in length and 8 inches wide.



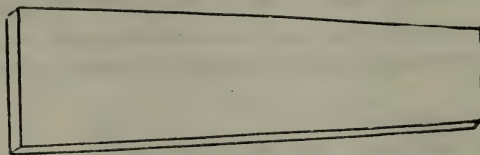
Add together the two parallel sides, and divide their sum by 2, multiply the result by the inches in width and divide by 12. The answer is 12 feet Board Measure contents.

Operation:

$$\begin{array}{r}
 16 \\
 20 \\
 \hline
 2) 36 \\
 \hline
 18 \\
 8 \\
 \hline
 12) 144
 \end{array}$$

12 ft. Board Measure.

Find the Board Measure contents of a board one inch thick, 24 feet long whose parallel ends are 10 inches and 18 inches respectively.



Operation:

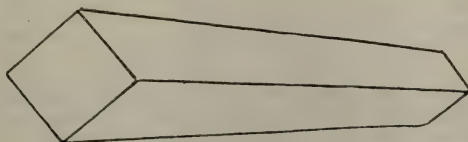
$$\begin{array}{r}
 10 \\
 18 \\
 \hline
 2) 28 \\
 \hline
 14 \\
 24 \\
 \hline
 12) 336
 \end{array}$$

28 ft. Board Measure.

HOW TO FIGURE THE FRUSTUM OF A PYRAMID, OR TAPERING TIMBER

As it frequently occurs there is a difference of opinion as to the correct way of ascertaining the Board Measure contents of tapering timber, the following method is both simple and correct, and will enable anyone to figure the exact contents without diving into square root.

Find the contents of a timber 40 feet high, 12x12 inches at the bottom and 6x6 inches at the top.



Square both ends separately, then multiply the top by the bottom side, add the sum together, and multiply this by the height and in all cases divide by 36.

Operation:

| | |
|-------|-------------------|
| 12x12 | 144 bottom |
| 6x 6 | 36 top |
| 6x12 | 72 top and bottom |

252
40 ft. high

36) 10080 (280 ft. B. M.—Ans.

72

288

288

0

The common error that would be made in figuring a timber of this dimension would be to call it 9x9 the supposed size at the middle; the contents in that case would be 270 feet, or a difference of 10 feet. This is an important item that should be taken into consideration when figuring on contracts or freight.

I will now prove the method I use is correct by figuring a square timber on the same principal as a tapering stick.

Find the Board Measure contents of a timber 12 inches square and 40 feet long.

Operation:

| | |
|-------|--------------------|
| 12x12 | 144 bottom |
| 12x12 | 144 top |
| 12x12 | 144 top and bottom |

432
40 ft. long.

36) 17280 (480 ft. B. M. contents.

144

288

288

0

CONTENTS BY PROGRESSIVE ADDITION

This rule is of great advantage when there is a range of odd and even lengths.

Example 1: Find the number of lineal feet in the following:

| Ft. Long. | Pieces. | Lin. Ft. |
|-----------|---------|----------|
| 10 | 0 | 480 |
| 11 | 8 | 48 |
| 12 | 6 | 40 |
| 13 | 4 | 34 |
| 14 | 7 | 30 |
| 15 | 23 | 23 |
| | <hr/> | <hr/> |
| | 48 | 655 |

Explanation: First put down the pieces of the longest length (23 Pcs.) to this, add the pieces of the next longest length (7 Pcs.), which makes 30, put this down over the 23; now add to this the next number of pieces (4), which makes 34; add the next number (6), which makes 40; to this add the 8, which makes 48. The last item, in this case 48, if correct, will correspond with the total number of pieces.

This number (48) is multiplied by the shortest length, minus one, which in this case is ten. Now 48×10 equals 480; add this amount to the figures already obtained and the grand total is the number of lineal feet (655), not board feet.

When there are missing lengths repeat the number of pieces as shown by the following example:

Example 2:

| Ft. Long. | Pieces. | Lin. Ft. |
|-----------|---------|----------|
| 12 | 0 | 924 |
| 13 | 15 | 77 |
| 14 | 0 | 62 |
| 15 | 19 | 62 |
| 16 | 0 | 43 |
| 17 | 43 | 43 |
| | <hr/> | <hr/> |
| | 77 | 1211 |

Explanation: In the foregoing example there are no pieces 14 or 16 feet long, so the amounts are repeated when there is a blank length. As in Example No. 1, the total pieces are multiplied by the shortest length, minus one. In this instance the 77 pieces are multiplied by 12, which gives 924, and the total addition shows 1211, the lineal feet.

FOR EVEN LENGTHS ONLY

Find the number of lineal feet in the following:

| Ft. Long. | Pieces. | Lin. Ft. |
|-----------|---------|----------|
| 12 | 46 | 287 |
| 14 | 54 | 241 |
| 16 | 62 | 187 |
| 18 | 58 | 125 |
| 20 | 67 | 67 |
| | <hr/> | <hr/> |
| | 287 | 907 |
| | | 907 |
| | | 2870 |
| | | <hr/> |
| | | 4684 |

Explanation: This system is the same as the preceding examples, with the exception that the addition (907) is repeated or doubled, and to this is added the number of pieces (287) multiplied by the next shortest even length (10). These items are now added together and the result shows the lineal feet (4684).

CARGO SPECIFICATIONS

As there does not seem to be any fixed rule for making up specifications in a uniform manner, reference to this subject will not be out of place. Some mills adopt the system of making all Domestic and Foreign Export Specifications out in feet Board Measure for each size and length, while others make out their specifications in lineal feet for each length and then add up their total and bring same to Board Measure.

The latter system of making out the extensions in lineal feet should be universally adopted, as everyone who is familiar with this class of work knows that a specification with the extensions in lineal feet, and showing the totals in Board Measure, can be finished in a quarter the time of a specification that shows the feet Board Measure for each length.

Steam schooners often arrive at San Francisco before the cargo manifest reaches consignee; this inconvenience and delay could often be avoided by the time gained in making up specifications with the extensions in lineal feet instead of Board Measure.

Foreign buyers, especially in the British trade, use the lineal measure more extensively than any other, and when they receive specifications in feet Board Measure they are put to the unnecessary inconvenience of converting them to lineal feet to correspond with their tables and price lists.

SHORT METHOD OF FIGURING SPECIFICATIONS

A very easy and short method of obtaining the Board Measure contents of each size and length, when required, is to halve the length and double the thickness. Simple as this rule seems, it is unknown to many experts.

Example: Find the Board Measure contents of each length in the following size:

| Pieces. | Size. | Length. | B. M. Feet |
|----------|--------|---------|---------------|
| 53 | 2 x 10 | 12 | 1060 |
| 42 | 2 x 10 | 14 | 980 |
| 36 | 2 x 10 | 16 | 960 |
| 48 | 2 x 10 | 10 | 1440 |
| 36 | 2 x 10 | 20 | 1200 |
| 30 | 2 x 10 | 22 | 1100 |
| 12 | 2 x 10 | 24 | 480 |
| <hr/> | | | <hr/> |
| 257 | | | 7220 |

In the above example, instead of saying twelve times fifty-three, halve the length and say six times fifty-three is three hundred and eighteen (318); now by doubling the thickness, we have the equal of 4x10 stead of 2x10; therefore, by adding a cipher to the 318 and dividing by 3, we have the Board Measure contents of the first length. The same rule applies to the remainder of lengths.

When it is only necessary to find the total feet Board Measure in a size containing a range of lengths, halve the lengths or pieces, and multiply the total result by the multiple of double the thickness of the size.

Example: Find the total feet Board Measure contained in the following:

| Pieces. | Size. | Length | Contents. |
|-----------|-------|--------|-----------|
| 224 | 3 x 6 | 16 | 1792 |
| 112 | 3 x 6 | 18 | 1008 |
| 568 | 3 x 6 | 20 | 5680 |
| 45 | 3 x 6 | 22 | 495 |
| 120 | 3 x 6 | 24 | 1440 |
| <hr/> | | | <hr/> |
| 1069 | | | 10415 |
| | | | 3 |

Feet B. M. 31245

HOW TO DECREASE OR INCREASE ORDERS

The method of decreasing or increasing orders will now be explained. Reduce the following order by 44,000 feet Board Measure:

240,000 feet 12x12—40 to 60
 280,000 feet 14x14—40 to 60
 420,000 feet 16x16—40 to 60
 160,000 feet 18x18—40 to 60

1,100,000

The first step necessary is to find the required percentage to reduce order in proportion. This is done by adding two ciphers to the amount that the order is to be reduced by and dividing the result by the amount of order. In this case it is 4 per cent. Each item must now be reduced separately by the percentage obtained, as follows:

| Amt. of Decrease. | Original Order. | Reduced Order. |
|--|-----------------|----------------|
| 9,600 ft. or 4% from 240,000 ft. leaves | 240,000 | 230,400 |
| 11,200 ft. or 4% from 280,000 ft. leaves | 280,000 | 268,800 |
| 16,800 ft. or 4% from 420,000 ft. leaves | 420,000 | 403,200 |
| 6,400 ft. or 4% from 160,000 ft. leaves | 160,000 | 153,600 |
| 44,000 | 1,100,000 | 1,056,000 |

If the above order of 1,100,000 feet had to be increased by 44,000 feet, 4% would be added to each item, and the total would show the amount of order when increased.

FIGURING PERCENTAGES

Cargo orders for California usually call for stipulated percentages of Nos. 1 and 2 in the merchantable grades and clear and select in the uppers.

During progress of loading, it is essential to keep posted on the proportion of the percentage so as to avoid over-running or falling short on a grade.

Presume an order calls for 800,000 feet Nos. 1 and 2 Mcht., 25% No. 2 allowed, and in figuring up to see how your percentage is, you find your order stands thus:

306,600 ft. No. 1
 113,400 ft. No. 2

420,000 ft. Total on board.

The following is the way to find your percentage:

Cut off the two right hand figures in your total (420,000) and divide the remaining amount (4200) into the Nos. 1 and 2 respectively. If your answer is correct your combined percentages will add to 100.

Operation:

| No. 1 Mcht. | No. 2 Mcht. |
|-------------------|-------------------|
| 4200) 306600 (73% | 4200) 113400 (27% |
| 29400 | 8400 |
| 12600 | 29400 |
| 12600 | 29400 |

Amount of Percentage

306,600 No. 1 or 73% of 420,000
 113,400 No. 2 or 27% of 420,000

420,000 Total 100%

As your No. 2 in this instance exceeds the 25 % allowed, notify the proper authorities of the fact, so that arrangements can be made to bring grade up to the required percentage.

STANDARDS

The "St. Petersburg Standard" is used in Great Britain, almost to the entire exclusion of all other standards.

The wholesale trade as a rule sells boards, battens, deals, planks, etc., by the Standard.

The Standard (St. Petersburg) deal contains 1 piece 3x11—6 feet and 120 pieces of this dimension make one Standard.

COMPOSITION OF STANDARDS

| Pcs. | Size. Length. | | B. M Cu. Ft. | Contents. |
|------------------------|---------------|-------|--------------|-----------|
| | Inches. | Feet. | | |
| St. Petersburg ....120 | 1½x11 | 12 | 1980 | 165 |
| Irish or London ..120 | 3 x 9 | 12 | 3240 | 270 |
| Christiana .....120 | 1¼x 9 | 11 | 1237½ | 103⅓ |
| Drammen .....120 | 2½x 6½ | 9 | 1462½ | 121⅔ |
| Quebec .....100 | 2½x11 | 12 | 2750 | 229⅔ |

The Drontheim Standard varies for different kinds of lumber. It contains:

2376 feet B. M. of Sawn Deals.

2160 feet B. M. of Square Timber.

1728 feet B. M. of Round Timber.

The Wyburg Standard contains:

2160 feet B. M. of Sawn Deals.

1963⅔ feet B. M. of Square Timber.

1560 feet B. M. of Round Timber.

100 St. Petersburg Standard Deals equal 60 Quebec Deals.

The Riga "Last" contains 960 feet B. M. of Sawn Deals or Square Timber.

A Cubic Fathom of Lathwood is 6 ft. x 6 ft. and contains 216 cubic feet or 2592 feet B. M.

A Gross Hundred (120) pieces) makes a Standard Hundred.

FIGURING OF STANDARDS

Bring the following specification to Standard Measurement:

| | |
|-----------------|----|
| 24 Pieces ¾x5½ | 24 |
| 20 Pieces 1 x6 | 16 |
| 20 Pieces 1 x12 | 20 |
| 40 Pieces 2 x10 | 24 |
| 10 Pieces 2 x12 | 22 |

Reduce each item as follows by multiplying the number of Pieces and all their dimensions together.

| | | |
|------------|-----------|------------|
| 24x¾x5½x24 | 20x1x6—16 | 20x1x12—20 |
| ¾ | 1 | 1 |
| 18 | 20 | 20 |
| 5½ | 6 | 12 |
| 99 | 120 | 240 |
| 24 | 16 | 20 |
| 2376 | 1920 | 4800 |

When the products are obtained, then add together the total number of inches as shown in the specification below, which totals:

| | |
|----------------|------------------|
| 24 Pieces ¾x5½ | 24— 2376 inches. |
| 20 Pieces 1x6 | 16— 1920 inches. |
| 20 Pieces 1x12 | 20— 4800 inches. |
| 40 Pieces 2x10 | 24—19200 inches. |
| 10 Pieces 2x12 | 22— 5280 inches. |

33576 inches.

Always divide the total (in this instance 33576) by the following figures, which are standing divisors and never vary; thus:

1)33576

18)3052

30)169 $\frac{10}{18}$

4)5.19 $\frac{10}{18}$

Std. Quarters. Deals. Parts.

1.1.19 $\frac{10}{18}$ equals, 1 1 19 $\frac{10}{18}$

FREIGHT MEASUREMENT OF TIMBER AS USED IN ENGLAND

A St. Petersburg Standard Hundred contains 120 pieces of 12 feet \times 1½ inches \times 11 inches=165 cubic feet, or 1,980 superficial feet of 1 inch.

Deals, battens, scantings, rough boards, and sawn pitch pine timber, pay freight per St. Petersburg Standard Hundred.

Planed boards pay freight on actual measure when dressed, not by the specification of nominal sizes from which they are manufactured.

Squared timber pays freight per load of 50 cubic feet, Queen's calliper measure delivered.

Mahogany and cedar from Cuba pay freight per load of 50 cubic feet, Queen's calliper measure, the captain paying the measuring charge.

Most furniture woods pay freight per ton weight delivered.

1 shipping ton equals 42 cubic feet of Timbers.

| | |
|-------------------------------------|-----------------|
| 100 Superficial feet of planking | equal 1 square |
| 120 Deals | equal 1 hundred |
| 50 Cubic feet of squared timbers | equal 1 load |
| 40 Cubic feet of unhewn timbers | equal 1 load |
| 600 Superficial feet of inch boards | equal 1 load |
| 216 Cubic feet of lathwood | equal 1 fathom |
| 108 Cubic feet of wood | equal 1 stack |
| 128 Cubic feet of wood | equal 1 cord |

Timber at 50 cube feet to one ton.

Pitchpine, Spruce, Whitewood, Redwood, Elm, Walnut, Maple, Pine, Baltic, Dantzig, Riga, and Memel Fir Timber are computed as weighing 50 cubic feet to the ton.

Timber at 40 cube feet to one ton

Birch, Oak, Ash, Elm, Mahogany, Teak, Beech, Green Heart, Hickory, and Round Timber generally are computed as weighing 40 cubic feet to the ton.

TO FIGURE CAPACITY OF FREIGHT CARS

LUMBER

To find the amount of Rough Green Lumber any car will carry, cut off a cipher from the marked capacity in pounds, add 10 per cent. and multiply by 3; the result will be the limit of feet Board Measure the car is allowed to carry.

Example: What is the limit in feet Board Measure allowed a car of 80,000 pounds capacity?

8000 pounds.

800 10 per cent.

8800x3 equals 26,400 ft. Board Measure.—Answer.

SHINGLES

To find approximate number of 16-inch Shingles that can be loaded in a box car.

Ascertain cubical capacity of the car, and to the number of cubic feet add two ciphers; the result will be the number of Shingles.

When loading Shingles or Lumber in furniture cars, precautions should be taken against exceeding the weight limit.

OCTAGON SPARS

As the custom is now becoming general to order Octagon Spars, both Sawn and Hewn, the information on this subject will be appreciated by those who make a specialty of this line.

An Octagon can be made out of a Square timber by the following rule:

From diagonal deduct one side of timber, and that will give one side of the Octagon.

To find the length of the side of the triangle to be taken off the corner of the timber at right angles to the diagonal, deduct half the diagonal from one side of the timber.

One side of a square timber dividid by .707 gives the diagonal.

Example:

Find the length of one side of an Octagon that can be made out of a timber 35 inches square.

Diagonal of $35 \times 35 = 49.50$ inches.

One side of $35 \times 35 = 35.00$ inches.

One side of Octagon $= 14.50$ inches.

Example:

What is the length of the side of a triangle to be taken off the corner of a timber 35 inches square to make an Octagon?

Process:

2)49.50 Dagonal

24.75 Half the Diagonal.

35.00 Inches one side of timber.

24.75 Inches, half the diagonal.

10.25 Inches length of one side of triangle.

To find one side of an Octagon inscribed in a circle, multiply diameter by .38265.

To find area of an Octagon multiply square of side by 4.82843.

When one side of a square is given, to find one side of an Octagon, that can be made out of it—multiply one side of square by .41421.

When one side of an Octagon is given, to find the diameter of the circumscribed circle, multiply one side of the Octagon by 2.613.

TO COMPUTE THE BOARD FEET CONTENTS OF AN OCTAGON

To compute the board feet contents of an octagon multiply the square of one side of the Octagon by 4.82843; then multiply the result by the length and divide by 12.

Example:

Find the board feet contents of an Octagon, one side of which is 4 inches and the length 60 feet.

Process:

Multiplied by 4.82843 decimal term
16 the square of 4

77.25488

Multiplied by 60 the length

Divided by 12)4635.29280

386.2744 Board Feet Contents.

ANOTHER METHOD

To compute the board feet contents of an Octagon manufactured out of a square timber.

First find the contents of the square timber in the usual way, then square one side of the Octagon; multiply it by the length and divide by 12; subtract this amount from the contents of the square timber and the result will give the board feet contents of the Octagon.

Example:

Find the board feet contents of an Octagon the side of which is $14\frac{1}{2}$ inches, made of a timber 35 inches square and 60 feet long.

Process:

$35" \times 35" = 60$ ft. equals 6125 Board Feet.

$14\frac{1}{2} \times 14\frac{1}{2} = 60$ ft. equals $1051\frac{1}{4}$ Board Feet.

Contents of the Octagon $5073\frac{3}{4}$ Board Feet.

Note:

The exact side of a square from which an Octagon of $14\frac{1}{2}$ inches could be made, would be 35.0065 inches. In the foregoing example the figures past the decimal point, namely .0064 are discarded as being unnecessary for practical purposes.

EXPLANATION OF OCTAGON TABLE

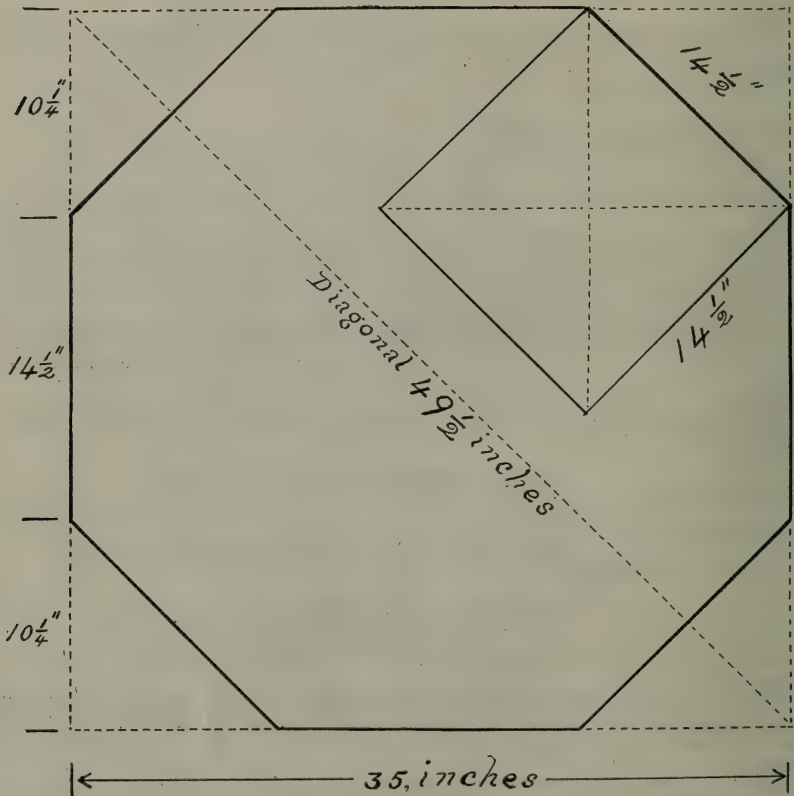
See Table on page 29.

First Column shows the size of the timber to be made into an Octagon.

Second Column shows the diagonal or the length of a line joining the opposite angles of the timber.

Third Column shows the length of one side of the Octagon that can be made from the timber in First Column.

Fourth Column shows the length of one side of the triangle to be cut off each corner of the timber at right angles to the diagonal to make the Octagon.



The above diagram illustrates the system used in determining the contents of an Octagon. Note that one side of the square (35) deducted from the diagonal (49½) gives one side of the Octagon, and that the side of the small inner square equals one side of the Octagon. You will also observe that the area of the small square or combined areas of the four sections of the small square is the equivalent to the total area of the four corners taken off the large square to make the Octagon.

USEFUL TABLE FOR MAKING OCTAGONS OUT OF SQUARE TIMBER

| Square Timber First Column | Diagonal Second Column | One Side of Octagon Third Column | One Side of Corner Fourth Column | Square Timber First Column | Diagonal Second Column | One Side of Octagon Third Column | One Side of Corner Fourth Column |
|-------------------------------------|------------------------------|---|---|-------------------------------------|------------------------------|---|---|
| 6x6 | 8.48 | 2.48 | 1.76 | 22x22 | 31.12 | 9.12 | 6.44 |
| 7x7 | 9.90 | 2.90 | 2.05 | 23x23 | 32.53 | 9.53 | 6.73 |
| 8x8 | 11.31 | 3.31 | 2.35 | 24x24 | 33.95 | 9.95 | 7.02 |
| 9x9 | 12.73 | 3.73 | 2.63 | 25x25 | 35.36 | 10.36 | 7.32 |
| 10x10 | 14.14 | 4.14 | 2.93 | 26x26 | 36.78 | 10.78 | 7.61 |
| 11x11 | 15.56 | 4.56 | 3.22 | 27x27 | 38.19 | 11.19 | 7.90 |
| 12x12 | 16.97 | 4.97 | 3.51 | 28x28 | 39.60 | 11.60 | 8.20 |
| 13x13 | 18.39 | 5.39 | 3.81 | 29x29 | 41.02 | 12.02 | 8.49 |
| 14x14 | 19.80 | 5.80 | 4.10 | 30x30 | 42.43 | 12.43 | 8.78 |
| 15x15 | 21.22 | 6.22 | 4.39 | 31x31 | 43.85 | 12.85 | 9.07 |
| 16x16 | 22.63 | 6.63 | 4.69 | 32x32 | 45.26 | 13.26 | 9.37 |
| 17x17 | 24.05 | 7.05 | 4.97 | 33x33 | 46.68 | 13.66 | 9.66 |
| 18x18 | 25.46 | 7.46 | 5.27 | 34x34 | 48.09 | 14.09 | 9.95 |
| 19x19 | 26.87 | 7.87 | 5.56 | 35x35 | 49.50 | 14.50 | 10.25 |
| 20x20 | 28.29 | 8.29 | 5.85 | 36x36 | 50.90 | 14.92 | 10.54 |
| 21x21 | 29.70 | 8.70 | 6.15 | | | | |

TO COMPUTE THE AREA OF A REGULAR POLYGON

When length of a side only is given.

Rule: Multiply square of the side by multiplier opposite to term of polygon in the following table:

| No. of Sides | Polygon | Multiplier |
|-----------------|-----------|------------|
| 3 | Trigon | .43301 |
| 4 | Tetragon | 1. |
| 5 | Pentagon | 1.72048 |
| 6 | Hexagon | 2.59808 |
| 7 | Heptagon | 3.63391 |
| 8 | Octagon | 4.82843 |
| 9 | Nonagon | 6.18182 |
| 10 | Decagon | 7.69421 |
| 11 | Undecagon | 9.36564 |
| 12 | Dodecagon | 11.19615 |

TO COMPUTE THE BOARD FEET CONTENTS OF A REGULAR POLYGON

Rule: Multiply square of the side by multiplier opposite to the term of polygon in the foregoing table; then multiply the result by the length and divide by 12.

Example:

Find the board measure contents of a Nonagon (9 equal sides) one side of which is 6 inches and the length is 30 feet.

Process:

6.18182 Decimal Term
Multiplied by 36 the square of 6 inches

37.09092
185.4546

222.54552
Multiplied by 30 the length

Divided by 12) 6676.36560

556.36380 Board Feet Contents.

TO COMPUTE CONTENTS OF A TAPERING OCTAGON OR FRUSTUM OF A PYRAMID

Rule:

To the sums of the areas of the two ends of the tapering octagon or frustum add the square root of their product. Multiply the sum by the height and take one-third of the product.

Example:

Find the cubic contents of a frustum of a pyramid whose height is 15 feet. The area of one end is 18 square feet and the other 98 square feet.

Operation:

18+98=116 (area of the two ends).
98x18=1764 square root of 1764=42.
116+42=158 15 (height)x158=2370, which divided by 3 gives 790 cubic feet.

Remark:

This rule also applies to frustums of cones.

—Contents of 1-inch Boards of Different Lengths and Widths Given in Board Feet and
Twelfths.

| WIDTH OF BOARD (INCHES). | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------|----|----|-----|----|------|-----|-----|------|------|----|------|------|-----|-----|------|-----|------|-----|-----|------|------|----|--|
| Length. | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
| CONTENTS (BOARD FEET). | | | | | | | | | | | | | | | | | | | | | | | |
| Feet. | 1 | 14 | 18 | 2 | 24 | 28 | 3 | 34 | 38 | 4 | 44 | 48 | 5 | 54 | 58 | 6 | 64 | 68 | 7 | 74 | 78 | 8 | |
| 4 | 13 | 18 | 21 | 2 | 21 | 34 | 39 | 42 | 47 | 5 | 55 | 510 | 63 | 68 | 71 | 76 | 711 | 84 | 89 | 92 | 97 | 10 | |
| 5 | 16 | 2 | 26 | 3 | 36 | 4 | 46 | 5 | 56 | 6 | 66 | 7 | 76 | 8 | 86 | 9 | 96 | 10 | 106 | 11 | 116 | 12 | |
| 6 | 19 | 24 | 211 | 36 | 4 | 48 | 53 | 510 | 65 | 7 | 77 | 82 | 89 | 94 | 911 | 106 | 111 | 118 | 123 | 1210 | 136 | 14 | |
| 7 | 22 | 28 | 34 | 4 | 48 | 54 | 6 | 68 | 74 | 8 | 88 | 94 | 10 | 108 | 114 | 12 | 128 | 134 | 148 | 154 | 16 | 16 | |
| 8 | 23 | 3 | 39 | 46 | 53 | 6 | 69 | 76 | 83 | 9 | 99 | 106 | 113 | 12 | 129 | 136 | 143 | 15 | 159 | 168 | 173 | 18 | |
| 9 | 26 | 34 | 42 | 5 | 510 | 68 | 76 | 84 | 92 | 10 | 1010 | 120 | 129 | 134 | 142 | 15 | 1510 | 168 | 176 | 184 | 192 | 20 | |
| 10 | 29 | 38 | 47 | 56 | 65 | 74 | 83 | 92 | 101 | 11 | 1111 | 1200 | 129 | 148 | 157 | 166 | 175 | 184 | 193 | 202 | 211 | 22 | |
| 11 | 32 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
| 12 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
| 13 | 33 | 44 | 55 | 66 | 77 | 88 | 99 | 1010 | 1111 | 13 | 141 | 132 | 163 | 174 | 185 | 196 | 207 | 218 | 229 | 2310 | 2411 | 26 | |
| 14 | 36 | 48 | 61 | 74 | 87 | 94 | 106 | 118 | 1210 | 14 | 152 | 164 | 176 | 188 | 1910 | 21 | 222 | 234 | 246 | 258 | 2610 | 28 | |
| 15 | 39 | 5 | 63 | 76 | 89 | 10 | 113 | 126 | 139 | 15 | 163 | 176 | 189 | 20 | 213 | 226 | 239 | 25 | 263 | 276 | 289 | 30 | |
| 16 | 4 | 54 | 68 | 8 | 94 | 108 | 12 | 134 | 148 | 16 | 174 | 188 | 20 | 214 | 228 | 24 | 254 | 268 | 28 | 294 | 308 | 32 | |
| 17 | 46 | 6 | 76 | 9 | 106 | 12 | 136 | 15 | 168 | 18 | 196 | 21 | 226 | 24 | 256 | 27 | 286 | 30 | 316 | 33 | 346 | 36 | |
| 18 | 49 | 8 | 98 | 11 | 1210 | 148 | 166 | 184 | 202 | 22 | 2310 | 258 | 276 | 294 | 312 | 33 | 3410 | 368 | 386 | 404 | 42 | 44 | |
| 19 | 52 | 10 | 118 | 14 | 16 | 18 | 19 | 22 | 25 | 28 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | |
| 20 | 55 | 12 | 13 | 15 | 17 | 19 | 21 | 23 | 26 | 29 | 26 | 28 | 30 | 32 | 34 | 36 | 39 | 41 | 43 | 45 | 47 | 50 | |
| 21 | 58 | 14 | 164 | 18 | 164 | 188 | 21 | 234 | 258 | 28 | 304 | 328 | 35 | 374 | 398 | 42 | 444 | 468 | 49 | 514 | 538 | 56 | |
| 22 | 61 | 16 | 176 | 20 | 176 | 20 | 226 | 25 | 276 | 30 | 326 | 35 | 376 | 40 | 426 | 45 | 476 | 50 | 528 | 55 | 576 | 60 | |
| 23 | 64 | 18 | 188 | 21 | 188 | 214 | 24 | 268 | 294 | 32 | 348 | 374 | 40 | 428 | 454 | 48 | 508 | 534 | 56 | 588 | 614 | 64 | |

TO COMPUTE SIZES NOT GIVEN IN THE BOARD MEASURE TABLE

A great variety of sizes can be computed or checked by the aid of the foregoing table.

If you wish to figure the contents of fractional lumber, plank, square or rectangular timbers the table can be used for that purpose.

For lumber $1\frac{1}{4}$ inches in thickness add $\frac{1}{4}$ to the amount given in the table for a board of corresponding width and length.

For lumber $1\frac{1}{2}$ inches in thickness you would add half the amount to the contents.

For lumber 2 inches in thickness double the amount of contents. In other words when the thickness exceeds one inch multiply the board feet amounts given in the table by the thickness.

EXAMPLES

Fractional Sizes—Find the contents of 1 piece $1\frac{1}{4} \times 17$, 20 feet long.

By referring to the table you will find 1 piece 1×17 , 20 feet long, contains 28 feet and 4 inches, to this is added one quarter (7 ft. 1 in.) which gives 35 feet 5 inches, the board feet contents of 1 piece $1\frac{1}{4} \times 17$, 20 feet long.

If the board were $1\frac{1}{2}$ inches in thickness you would add to the contents of 1×17 , half the amount.

Square timbers—Find the contents of 1 piece 18×18 , 20 feet long.

According to the table, 1 piece 1×18 20 contains 30 board feet, the amount multiplied by one side of the square (18) gives 540, the board feet contents.

Rectangular Timbers—Find the contents of 1 piece 15×24 32 feet long.

In this case you can multiply the contents of 1×15 32 (40 feet contents) by 24, or 1×24 32 (64 feet contents) by 15, the result will be the same, namely 960 board feet contents.

Totals—In the table the fractions are given in twelfths (small figures) making adding easier. Thus the following 1 inch lumber would be added:

| | | |
|-------------------------------|--------|---------------|
| 1 piece 1×7 —10 ft. | equals | 5 ft. 10 ins. |
| 1 piece 1×10 —12 ft. | equals | 10 ft. 0 ins. |
| 1 piece 1×16 —12 ft. | equals | 16 ft. 0 ins. |
| 1 piece 1×13 —14 ft. | equals | 15 ft. 2 ins. |
| 1 piece 1×20 —16 ft. | equals | 26 ft. 8 ins. |

Total equals 72 and $20/12$ ft., or $73\frac{2}{3}$ board ft.

To find the total contents of lumber thicker than 1 inch, proceed as if the lumber were 1 inch and multiply the total by the thickness.

In the foregoing example, if it were 3-inch lumber the total would be multiplied by 3, or a total of 221 board feet.

TO COMPUTE AN AVERAGE RANGE OF LENGTHS

When an order such as 3x8 and wider calls for an average length, use the following system to compute it:

Rule:

Add together the total pieces of each length, and multiply the pieces by their respective lengths; then add separately the pieces and lengths, and divide the grand total of pieces into the grand total of lengths. The result will be the average length.

Example:

Find the average length of a range of widths such as 3x8 and wider.

Process:

| Pieces | Length | Lin. Ft. |
|------------------------------------|--------|----------|
| 23 multiplied by 16 ft. equal | | 368 |
| 9 multiplied by 18 ft. equal | | 162 |
| 34 multiplied by 20 ft. equal | | 680 |
| 79 multiplied by 22 ft. equal | | 1738 |
| 12 multiplied by 24 ft. equal | | 288 |
| 11 multiplied by 26 ft. equal | | 286 |
| 8 multiplied by 28 ft. equal | | 224 |
| 7 multiplied by 30 ft. equal | | 210 |
| 7 multiplied by 32 ft. equal | | 224 |
| <hr/> | | |
| 190 Pieces, divided into | | 4180 |
| gives 22 feet, the average length. | | |

TO COMPUTE AVERAGE WIDTHS

Orders from Europe frequently call for an average in width of a specified thickness, such as 3x8 and wider, 4x10 and wider, 6x12 and wider. The following is the system for striking an average:

Rule:

Multiply the total pieces of each width separately; then add totals separately, and divide total of pieces into total of widths. The result will be the average width.

Example:

An item on an order calls for a specified amount of 4x10 and wider, to average 15 inches or over in width. The following pieces and widths have been sawn on this item; what is the present average?

Process:

| Total Pieces | Each Width | Totals of Pieces and Width's Multiplied |
|-----------------|---------------|---|
| 16 | x 10 equals | 160 |
| 24 | x 11 equals | 264 |
| 20 | x 12 equals | 240 |
| 42 | x 13 equals | 546 |
| 30 | x 14 equals | 420 |
| 40 | x 15 equals | 600 |
| 50 | x 16 equals | 800 |
| 20 | x 18 equals | 360 |
| 48 | x 20 equals | 960 |
| <hr/> | | |

290 Pieces, divided into 4350
equals 15 inches, the average
width required.

BOARD MEASUREMENT OF LOGS

Board measure is designed primarily for the measurement of sawed lumber. The unit is the board foot, which is a board 1 inch thick and 1 foot square, so that with inch boards the content in board measure is the same as the number of square feet of surface; with lumber of other thicknesses the content is expressed in terms of inch boards.

In recent years board measure has been used as a unit of volume for logs. When so applied the measure does not show the entire content of the log, but the quantity of lumber which, it is estimated, may be manufactured from it. The number of board feet in any given log is determined from a table that shows the estimated number which can be taken out from logs of different diameters and lengths. Such a table is called a log scale or log rule, and is compiled by reducing the dimensions of perfect logs of different sizes, to allow for waste in manufacture, and then calculating the number of inch boards which remain.

The amount of lumber which can be cut from logs of a given size is not uniform, because the factors which determine the amount of waste vary under different circumstances, such as the thickness of the saw, the thickness of the boards, the width of the smallest board which may be utilized, the skill of the sawyer, the efficiency of the machinery, the defects in the log, the amount of taper, and the shrinkage. This lack of uniformity has led to wide differences of opinion as to how log rules should be constructed. There have been many attempts to devise a log rule which can be used as a standard, but none of them will meet all conditions. The rules in existence have been so unsatisfactory that constant attempts have been made to improve upon them. As a result there are now actually in use in the United States 40 or 50 different log rules, whose results differ in some cases as much as 120 per cent for 20-inch to 30-inch logs, and 600 per cent for 6-inch logs. Some of these are constructed from mathematical formulae; some by preparing diagrams that represent the top of a log and then determining the amount of waste in sawdust and slabs; some are based on actual averages of logs cut at the mill; while still others are the result of making corrections in an existing rule to meet special local conditions.

The large number of log rules, the differences in their values, and the variation in the methods of their application have led to much confusion and inconvenience. Efforts to reach an agreement among lumbermen on a single standard log rule have failed so far. A number of States have given official sanction to specific rules, but this has only added to the confusion, because the States have not chosen the same rule, so there are six different state log rules, and, in addition, three different official log rules in Canada. It is probable that a standard method of measuring logs will not be worked out satisfactorily until a single unit of volume, like the cubic or board foot, is adopted for the measurement of logs.—U. S. Forest Service Bulletin 36.

The Brereton Solid Log Table shows the exact or solid contents in board feet of logs or round timbers, which will be found invaluable in a large number of instances as enumerated in the following pages, and also for comparison with the Pacific Coast and other numerous log scales now in use.

It is only a question of time when both buyer and seller will recognize the absolute fairness and benefit to be derived from making sales on the exact contents of a log, as the variation in quality can then be adjusted by the variation in price.

It is unreasonable to measure pulp wood logs in terms of manufactured lumber, as the entire log is used in making pulp. Therefore a solid measure is more appropriate than the usual log scale making allowance for slab and saw kerf.

ADVANTAGES AND USES OF THE BRERETON SOLID LOG TABLE SHOWING EXACT BOARD MEASURE CONTENTS OF LOGS

Situations arise where it is essential to arrive at a close estimate for freight purposes of the exact or solid contents of logs or piling which are often shipped by vessel to Foreign or Domestic ports or when it is necessary to compute their weight prior to shipping by rail, with a view of ordering cars that will stand the strain of heavy and long logs, spars or timbers.

It is also indispensable for ship's officers and stevedores to know the contents and weight of large logs and spars to enable them to judge as to the advisability of adjusting or doubling up their gear to avoid smashing derricks and winches or otherwise breaking down machinery.

POUNDS PER DEADWEIGHT TON

When computing deadweight of lumber, coal, or general cargo carried by British vessels, it is customary to use the long ton of 2240 pounds.

WEIGHT OF DOUGLAS FIR LOGS OR PILING

Rafted logs or piling on account of being partly submerged in salt or fresh water, or freshly felled in the early summer months, will naturally weigh more than those felled in winter, or shipped direct on cars from forest to destination. To compute the approximate weight in pounds of rafted logs or piling, take average diameter including bark, then ascertain board measure contents by referring to the Brereton Solid Log Table and multiply the amount by 3.5.

For logs and piling shipped on cars multiply board measure contents by 3.4.

WEIGHT OF CREOSOTED DOUGLAS FIR PILES, POLES AND TIES

To compute weight in pounds of creosoted piles or poles, take average diameter, then ascertain board measure contents according to the Brereton Solid Log Table and multiply the amount by 3.5.

Butt treated or butt and top treated telephone, telegraph or electric light poles weigh about 3.4 pounds per board foot, exact contents.

Creosoted ties (sleepers) or lumber of small dimensions weigh about 3.6 pounds per board foot. Creosoted timbers weigh about 3.5 pounds per board foot.

POINTER FOR CHARTERER OR OWNERS OF VESSELS—TAINT FROM CREOSOTE

In making charters for vessels to carry creosoted piling or lumber, if possible arrange to carry this material on deck. If carried under deck it will taint perishable cargo in same compartment, or perishable cargo carried on the return voyage.

EFFECT OF CREOSOTE ON CARRYING CAPACITY

The difference in weight between creosoted and untreated ties must also be taken into consideration as this affects the carrying capacity to a considerable extent; for instance, a steamer with a deadweight cargo carrying capacity of 5400 long tons that would ordinarily carry 3,620,000 board feet of untreated fir ties would only carry 3,360,000 board feet of creosoted ties, a difference of 260,000 board feet.

GROWTH OF TREES

Since there is a marked tendency among timberland owners to cut their timber with an eye to the future, some knowledge of the growth of forest trees becomes important.

Trees grow by adding each year a layer of wood underneath the bark. Since each year contains only one growing season and the spring and summer part of this layer are not alike, each year's growth, layer, or "annual ring" usually is distinguishable. The central fact of tree growth is that each ring means a year. The exceptions to this are not important enough to merit notice here.

Trees growing in the heart of the forest are generally straight and tall as it is necessary for their leaves to receive sunlight and air sufficient for vitalizing the sap; the lower branches of these trees only last a few years when they die and fall off. On the edges of the forest the lower branches of the trees remain alive and active so that timber cut from such places is knotty and occasionally cross-grained, while that cut from the inside trees is straight-grained and contains a larger percentage of clear lumber.

ANNUAL RINGS

Annual rings denote the spring and summer growth of the tree; the spring ring is distinguished by its light color; it is invariably wider than the summer ring on account of its more rapid growth which produces a softer fiber. The summer ring is darker in color, is harder and has a much more solid appearance than the spring ring. The line of separation in annual rings is caused by the suspension of the growth of the stem during winter.

The annual rings are not always uniform as they are generally thicker on that side of the tree which has the longest exposure to the sun. For this reason the distance from pith to bark will often vary several inches; for instance, the measurement of a log from heart center to bark would be, say 15 inches on one side and 20 inches on the other.

The widest rings are found around the heart centre from whence they gradually diminish in thickness as they radiate towards the sap, where their growth is so compact that it is almost impossible to count them without the aid of a microscope.

In determining the strength of lumber which is the principal point when inspecting the merchantable grades generally used for high class constructional purposes, the width, uniformity and compactness of the growth of the annual rings should be carefully noted. When the summer ring is narrow and the spring ring wide or porous, weakness is the result. When the spring and summer rings are nearly equal in width and uniformly close, it denotes natural strength so requisite in the quality of lumber used for ship and bridge work, masts, spars, dredger spuds, derricks or similar purposes for which Douglas Fir is unequalled.

In small trees the annual rings are proportionately closer and more uniform from heart centre to bark than the larger species, though there are occasional exceptions.

The annual rings are larger at the top than at the base of tree.

Small and medium sized logs which range from 17 to 36 inches in diameter, as a rule produce excellent timbers and a good grade of merchantable lumber.

ANNUAL RINGS DENSITY AND DECAY

Specific gravity or density of lumber materially influences resistance to decay of the heart-wood; the more dense the wood the more durable it is. Specific gravity is a property which can not be determined from inspection, but it can be estimated by recourse to the proportion of summerwood to springwood in the annual growth rings which proves to be a safe criterion of the durability of heartwood; i. e., an increase in summer wood results in an increase in specific gravity. The specific gravity of Douglas Fir when freshly sawn is 640.

The width of the growth rings furnishes a further index of durability; the summer wood, which is of greater density and contains more pitch, shows more resistance to fungus attack than the spring rings of porous growth.

The resisting qualities of pitch to decay is principally through its waterproofing effect on wood, and thus its influence on the absorption of moisture by wood containing it; that is, the power of wood to absorb moisture is very important in its decay. It is well known that below a certain maximum of moisture in wood, fungi will not grow. Any property of the wood which will influence this balance of moisture is of importance in decay resistance. Thus, if the wood contains enough pitch to have a material waterproofing effect, it must play a role in durability.

DURABILITY OF WOOD

Timber cut in spring or in summer is not so durable as that cut in winter, when the life processes of trees are less active. Scientific investigations sustain this statement. The durability depends not only upon the greater or less density but also upon the presence of certain chemical constituents in the wood. Thus a large proportion of resinous matter increases the durability, while the presence of easily soluble carbohydrates diminishes it considerably.

During the growing season the wood of trees contains sulphuric acid and potassium, both of which are solvents of carbohydrates, starch, resins and gums; they are known to soften also the ligneous tissue to a considerable degree. During the summer months the wood of living trees contains eight times as much sulphuric acid and five times as much potassium as it does during the winter months. The presence of these two chemical substances during the growing season constitutes the chief factor in dissolving the natural preservatives within the wood and in preparing the wood for the different kinds of wood-destroying fungi, such as polyporus and agaricus. The fungi can thus penetrate more quickly and easily into the interior of the wood when these wood gums are already partly dissolved and available for their own immediate use.

From this standpoint it seems that the best time to cut down the tree is in the winter, when sulphuric acid and potassium are present to a much smaller degree, and the fungi will not be assisted in dissolving the natural preservatives in the wood. The amount of wood gum is always less and more easily soluble in sapwood than in heartwood.—Scientific American.

OLD GROWTH LOGS

In reference to lumber manufactured from "old growth" logs, it means that the trees from which they were logged are mature, of large diameter and grown in a virgin forest, and not from trees in a process of decay through age.

Old growth Douglas Fir furnishes excellent lumber for high grade wide clears, in either edge or slash grain.

DIAMETER GROWTH

Some trees grow so slowly that a hand lens is necessary to clearly distinguish the rings, others may have rings a half inch in width. In any case, a little practice improves the ability to note all the rings.

To find the age of a felled tree at any section, then, requires only the accurate counting of the rings. The total age of the tree is shown by the total number of rings at the ground; or the total number of rings on the stump plus the number of years required to grow as high as the stump. An examination of a number of small trees would give an idea of the time required to grow up to stump height. This varies from one year in trees coming up as stump sprouts to as high as twenty years or more in some Rocky Mountain conifers, for heights of 1 to 3 feet.

Since trees often grow faster on one side than another, the average growth is gotten only by finding the average radius and counting and measuring the rings along it. Thus the radius of the tree may be found at ten, twenty, thirty years, etc., and by doubling these the diameters are found at these ages.

DIFFERENTIAL TABLE

Table showing difference in board feet between actual contents of logs, 40 feet in length, 12 to 40 inches in diameter, and the Pacific Coast Log Scale's; also their respective allowances for slabs and saw kerf.

| | Allowance for Slabs | | Allowance for Slabs | | Allowance for Slabs | |
|------------------------------|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| | 12-in. and Saw Diam. | Kerf. | 14-in. and Saw Diam. | Kerf. | 16-in. and Saw Diam. | Kerf. |
| Actual Contents | 539 | ..... | 757 | ..... | 945 | ..... |
| Scribner Scale | 196 | 393 | 286 | 471 | 396 | 549 |
| Spaulding Scale | 192 | 397 | 286 | 471 | 402 | 543 |
| British Columbia Scale | 210 | 379 | 297 | 460 | 400 | 545 |

| | Allowance for Slabs | | Allowance for Slabs | | Allowance for Slabs | |
|------------------------------|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| | 18-in. and Saw Diam. | Kerf. | 20-in. and Saw Diam. | Kerf. | 22-in. and Saw Diam. | Kerf. |
| Actual Contents | 1155 | ..... | 1385 | ..... | 1636 | ..... |
| Scribner Scale | 534 | 621 | 700 | 685 | 836 | 800 |
| Spaulding Scale | 540 | 615 | 690 | 695 | 852 | 784 |
| British Columbia Scale | 518 | 637 | 652 | 733 | 800 | 836 |

| | Allowance for Slabs | | Allowance for Slabs | | Allowance for Slabs | |
|------------------------------|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| | 24-in. and Saw Diam. | Kerf. | 26-in. and Saw Diam. | Kerf. | 28-in. and Saw Diam. | Kerf. |
| Actual Contents | 1909 | ..... | 2202 | ..... | 2518 | ..... |
| Scribner Scale | 1010 | 899 | 1250 | 952 | 1456 | 1060 |
| Spaulding Scale | 1030 | 879 | 1220 | 982 | 1422 | 1094 |
| British Columbia Scale | 964 | 945 | 1145 | 1057 | 1337 | 1179 |

| | Allowance for Slabs | | Allowance for Slabs | | Allowance for Slabs | |
|------------------------------|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| | 30-in. and Saw Diam. | Kerf. | 32-in. and Saw Diam. | Kerf. | 34-in. and Saw Diam. | Kerf. |
| Actual Contents | 2851 | ..... | 3207 | ..... | 3584 | ..... |
| Scribner Scale | 1642 | 1209 | 1840 | 1367 | 2000 | 1584 |
| Spaulding Scale | 1640 | 1211 | 1870 | 1337 | 2112 | 1472 |
| British Columbia Scale | 1546 | 1305 | 1771 | 1436 | 2011 | 1573 |

| | Allowance for Slabs | | Allowance for Slabs | | Allowance for Slabs | |
|------------------------------|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| | 36-in. and Saw Diam. | Kerf. | 38-in. and Saw Diam. | Kerf. | 40-in. and Saw Diam. | Kerf. |
| Actual Contents | 3982 | ..... | 4401 | ..... | 4841 | ..... |
| Scribner Scale | 2304 | 1678 | 2670 | 1731 | 3010 | 1831 |
| Spaulding Scale | 2376 | 1606 | 2660 | 1741 | 2962 | 1879 |
| British Columbia Scale | 2266 | 1716 | 2536 | 1865 | 2822 | 2019 |

TAPER OF DOUGLAS FIR LOGS

The foregoing table is computed on the assumption that the 40-foot logs used as an example have an increase in taper of 6 inches, which is a fair average for this length of log.

To gauge the correct actual contents of a log, it is necessary to take the mean diameter, not the diameter at the small end, which is the usual method of scaling Douglas Fir logs; therefore to arrive at the actual contents given in the table, an increase of three inches over the diameter at the small end is allowed to give the correct mean diameter upon which the actual contents given in this table are based.

To display that the increase of 6 inches in taper is not excessive or used for the purpose of creating a disparity between the actual contents of logs as shown in the "Differential Table" and the scale according to log rules; carefully note in the following table the increase in taper of Douglas Fir logs from records kept by the United States Forest Service Department.

TAPER OF DOUGLAS FIR LOGS

| Total Length Feet | Butt Log | Log Lengths | | Top Log |
|-------------------------|-------------|---------------|--------------|------------|
| | | Second Log | Third Log | |
| 80 | 28' | 26' | .. | 26' |
| Increase | 7" | 5" | ... | 0" |
| 82 | 28' | 28' | ... | 26' |
| Increase | 7" | 5" | ... | 0" |
| 84 | 28' | 28' | ... | 28' |
| Increase | 8" | 5" | ... | 0" |
| 86 | 30' | 28' | ... | 28' |
| Increase | 8" | 5" | ... | 0" |
| 88 | 30' | 30' | ... | 28' |
| Increase | 8" | 5" | ... | 0" |
| 90 | 30' | 30' | ... | 30' |
| Increase | 8" | 6" | ... | 0" |
| 92 | 32' | 30' | ... | 30' |
| Increase | 8" | 6" | ... | 0" |
| 94 | 32' | 32' | ... | 30' |
| Increase | 8" | 6" | ... | 6" |
| 96 | 32' | 32' | ... | 32' |
| Increase | 9" | 6" | ... | 0" |
| 98 | 26' | 24' | 24' | 24' |
| Increase | 9" | 8" | 5" | 0" |
| 100 | 26' | 26' | 24' | 24' |
| Increase | 10" | 8" | 5" | 0" |

This table is intended to be used simply as a guide; the allowances for taper shown should be varied to conform to the actual taper. These figures are based on the actual taper of 110 Douglas Fir trees of average height measured in Washington and Oregon.

AVERAGE CONTENTS OF LOGS

To enable loggers and lumbermen to arrive at the average board feet in Douglas Fir and other species of Pacific Coast logs, with a view of comparing the difference between the solid or actual contents of logs, and the amounts according to the log rules in general use, the following table covers a record of the number of logs scaled and their contents, during the years 1913, 1914, 1915, 1916 and 1917, by the Puget Sound Log Scaling and Grading Bureau, Everett, Wash.

In the five years mentioned this Bureau scaled 4,604,000 logs containing 3,353,631,600 board feet. If the foregoing had been scaled according to their solid contents; i. e., without allowance for saw kerf and slab, the result would be about double the amount stated.

A fact that should not be lost sight of when comparing the difference between the solid contents and the amounts given in the standard log tables, is that the present method of scaling logs is invariably to take the diameter at the small end of the log, whereas in computing the solid contents, the mean or diameter at center of log is taken.

Table showing contents in board feet of an average log of Douglas Fir, Hemlock, Spruce, Cedar and miscellaneous species. Scaled by Puget Sound Log Scaling and Grading Bureau.

| | Number of Logs. | Board Feet Scale. | Log Average. | Pctg. |
|-------------------------|-----------------|-------------------|--------------|-------|
| No. 1 Douglas Fir | 92,671 | 256,496,830 | 2768 | 13 |
| No. 2 Douglas Fir | 1,044,589 | 1,123,440,220 | 1074 | 55 |
| No. 3 Douglas Fir | 1,184,594 | 659,725,000 | 556 | 32 |
| Total Douglas Fir | 2,321,854 | 2,039,662,050 | 878 | 61 |
| Western Hemlock | 635,838 | 303,023,270 | 476 | 09 |
| Sitka Spruce | 100,973 | 104,959,880 | 1039 | 03 |
| Western Cedar | 1,457,906 | 856,888,890 | 588 | 26 |
| *Miscellaneous | 87,429 | 49,097,510 | 564 | 01 |
| Total | 4,604,000 | 3,353,631,600 | 728 | |

*Miscellaneous includes the following: White Pine, White Fir, Maple, Cottonwood and Boomsticks.

BRERETON SOLID LOG TABLE

ACTUAL CONTENTS OF LOGS OR ROUND TIMBERS IN BOARD FEET

| Length in Feet | Average Diameter in Inches | | | | | | | | | | |
|-------------------|----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 16 | 38 | 51 | 67 | 85 | 105 | 127 | 151 | 177 | 205 | 236 | 268 |
| 18 | 42 | 58 | 75 | 95 | 118 | 143 | 170 | 199 | 231 | 265 | 302 |
| 20 | 47 | 64 | 84 | 106 | 131 | 158 | 188 | 221 | 257 | 295 | 335 |
| 22 | 52 | 71 | 92 | 117 | 144 | 174 | 207 | 243 | 282 | 324 | 369 |
| 24 | 57 | 77 | 101 | 127 | 157 | 190 | 226 | 265 | 308 | 353 | 402 |
| 26 | 61 | 83 | 109 | 138 | 170 | 206 | 245 | 288 | 334 | 383 | 436 |
| 28 | 66 | 90 | 117 | 148 | 183 | 222 | 264 | 310 | 359 | 412 | 469 |
| 30 | 71 | 96 | 126 | 159 | 196 | 238 | 283 | 332 | 385 | 442 | 503 |
| 32 | 75 | 103 | 134 | 170 | 209 | 253 | 302 | 354 | 411 | 471 | 536 |
| 34 | 80 | 109 | 142 | 180 | 223 | 269 | 320 | 376 | 436 | 501 | 570 |
| 36 | 85 | 115 | 151 | 191 | 236 | 285 | 339 | 398 | 462 | 530 | 603 |
| 38 | 90 | 122 | 159 | 201 | 249 | 301 | 358 | 420 | 487 | 560 | 637 |
| 40 | 94 | 128 | 168 | 212 | 262 | 317 | 377 | 442 | 513 | 589 | 670 |
| 42 | 99 | 135 | 176 | 223 | 275 | 333 | 396 | 465 | 539 | 619 | 704 |
| 44 | 104 | 141 | 184 | 233 | 288 | 348 | 415 | 487 | 564 | 648 | 737 |
| 46 | 108 | 148 | 193 | 244 | 301 | 364 | 434 | 509 | 590 | 677 | 771 |
| 48 | 113 | 154 | 201 | 254 | 314 | 380 | 452 | 531 | 616 | 707 | 804 |
| 50 | 118 | 160 | 209 | 265 | 327 | 396 | 471 | 553 | 641 | 736 | 838 |
| 52 | 123 | 167 | 218 | 276 | 340 | 412 | 490 | 575 | 667 | 766 | 871 |
| 54 | 127 | 173 | 226 | 286 | 353 | 428 | 509 | 597 | 693 | 795 | 905 |
| 56 | 132 | 180 | 235 | 297 | 367 | 443 | 528 | 619 | 718 | 825 | 938 |
| 58 | 137 | 186 | 242 | 307 | 380 | 459 | 547 | 642 | 744 | 854 | 972 |
| 60 | 141 | 192 | 251 | 318 | 393 | 475 | 565 | 664 | 770 | 884 | 1005 |

BRERETON SOLID LOG TABLE—Continued

ACTUAL CONTENTS OF LOGS OF ROUND TIMBERS IN BOARD FEET

| Length in Feet | Average Diameter in Inches | | | | | | | | | | |
|-------------------|----------------------------|------|------|------|------|------|------|------|------|------|------|
| | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 16 | 303 | 339 | 378 | 419 | 462 | 507 | 554 | 603 | 655 | 708 | 763 |
| 18 | 340 | 382 | 425 | 471 | 520 | 570 | 623 | 679 | 736 | 796 | 859 |
| 20 | 378 | 424 | 473 | 524 | 577 | 634 | 692 | 754 | 818 | 885 | 954 |
| 22 | 416 | 467 | 520 | 576 | 635 | 697 | 762 | 829 | 900 | 973 | 1050 |
| 24 | 454 | 509 | 567 | 628 | 693 | 760 | 831 | 905 | 982 | 1062 | 1145 |
| 26 | 492 | 551 | 614 | 681 | 750 | 824 | 900 | 980 | 1064 | 1150 | 1241 |
| 28 | 530 | 594 | 662 | 733 | 808 | 887 | 969 | 1056 | 1145 | 1239 | 1336 |
| 30 | 567 | 636 | 709 | 785 | 866 | 950 | 1039 | 1131 | 1227 | 1327 | 1431 |
| 32 | 605 | 679 | 756 | 838 | 924 | 1014 | 1108 | 1206 | 1309 | 1416 | 1527 |
| 34 | 643 | 721 | 803 | 890 | 981 | 1077 | 1177 | 1282 | 1391 | 1504 | 1622 |
| 36 | 681 | 763 | 851 | 942 | 1039 | 1140 | 1246 | 1357 | 1473 | 1593 | 1718 |
| 38 | 719 | 806 | 898 | 995 | 1097 | 1204 | 1316 | 1433 | 1554 | 1681 | 1813 |
| 40 | 757 | 848 | 945 | 1047 | 1155 | 1267 | 1385 | 1508 | 1636 | 1770 | 1909 |
| 42 | 794 | 891 | 992 | 1100 | 1212 | 1330 | 1454 | 1583 | 1718 | 1858 | 2004 |
| 44 | 832 | 933 | 1040 | 1152 | 1270 | 1394 | 1523 | 1659 | 1800 | 1947 | 2099 |
| 46 | 870 | 975 | 1087 | 1204 | 1328 | 1457 | 1593 | 1734 | 1882 | 2035 | 2195 |
| 48 | 908 | 1018 | 1134 | 1257 | 1385 | 1521 | 1662 | 1810 | 1964 | 2124 | 2290 |
| 50 | 964 | 1060 | 1181 | 1309 | 1443 | 1584 | 1731 | 1885 | 2045 | 2212 | 2386 |
| 52 | 984 | 1103 | 1229 | 1361 | 1501 | 1647 | 1800 | 1960 | 2127 | 2301 | 2481 |
| 54 | 1021 | 1145 | 1276 | 1414 | 1559 | 1711 | 1870 | 2036 | 2209 | 2389 | 2577 |
| 56 | 1059 | 1188 | 1323 | 1466 | 1616 | 1774 | 1939 | 2111 | 2291 | 2478 | 2672 |
| 58 | 1097 | 1230 | 1370 | 1518 | 1674 | 1837 | 2008 | 2187 | 2373 | 2566 | 2767 |
| 60 | 1135 | 1272 | 1418 | 1571 | 1732 | 1901 | 2077 | 2262 | 2454 | 2655 | 2863 |

BRERETON SOLID LOG TABLE—Continued**ACTUAL CONTENTS OF LOGS OF ROUND TIMBERS IN BOARD FEET**

| Length In Feet | Average Diameter in Inches | | | | | | | | | | |
|-------------------|----------------------------|------|------|------|------|------|------|------|------|------|------|
| | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| 16 | 821 | 881 | 942 | 1006 | 1072 | 1140 | 1211 | 1283 | 1357 | 1434 | 1512 |
| 18 | 924 | 991 | 1060 | 1132 | 1206 | 1283 | 1362 | 1443 | 1527 | 1613 | 1701 |
| 20 | 1026 | 1101 | 1178 | 1258 | 1340 | 1426 | 1513 | 1604 | 1696 | 1792 | 1890 |
| 22 | 1129 | 1211 | 1296 | 1384 | 1474 | 1568 | 1665 | 1764 | 1866 | 1971 | 2079 |
| 24 | 1232 | 1321 | 1414 | 1510 | 1608 | 1711 | 1816 | 1924 | 2036 | 2150 | 2268 |
| 26 | 1334 | 1431 | 1532 | 1635 | 1743 | 1853 | 1967 | 2085 | 2205 | 2330 | 2457 |
| 28 | 1437 | 1541 | 1649 | 1761 | 1877 | 1996 | 2118 | 2245 | 2375 | 2509 | 2646 |
| 30 | 1539 | 1651 | 1767 | 1887 | 2011 | 2138 | 2270 | 2405 | 2545 | 2688 | 2835 |
| 32 | 1642 | 1761 | 1885 | 2013 | 2145 | 2281 | 2421 | 2566 | 2714 | 2867 | 3024 |
| 34 | 1745 | 1871 | 2003 | 2139 | 2279 | 2423 | 2572 | 2726 | 2884 | 3046 | 3213 |
| 36 | 1847 | 1982 | 2121 | 2264 | 2413 | 2566 | 2724 | 2886 | 3054 | 3226 | 3402 |
| 38 | 1950 | 2092 | 2238 | 2390 | 2547 | 2708 | 2875 | 3047 | 3223 | 3405 | 3591 |
| 40 | 2053 | 2202 | 2356 | 2516 | 2681 | 2851 | 3026 | 3207 | 3393 | 3584 | 3780 |
| 42 | 2155 | 2312 | 2474 | 2642 | 2815 | 2994 | 3178 | 3367 | 3563 | 3763 | 3969 |
| 44 | 2258 | 2422 | 2592 | 2767 | 2949 | 3136 | 3329 | 3528 | 3732 | 3942 | 4158 |
| 46 | 2360 | 2532 | 2710 | 2893 | 3083 | 3279 | 3480 | 3688 | 3902 | 4122 | 4347 |
| 48 | 2463 | 2642 | 2827 | 3019 | 3217 | 3421 | 3632 | 3848 | 4072 | 4301 | 4536 |
| 50 | 2566 | 2752 | 2945 | 3145 | 3351 | 3564 | 3783 | 4009 | 4241 | 4480 | 4725 |
| 52 | 2668 | 2862 | 3063 | 3271 | 3485 | 3706 | 3934 | 4169 | 4411 | 4659 | 4915 |
| 54 | 2771 | 2972 | 3181 | 3396 | 3619 | 3849 | 4086 | 4330 | 4580 | 4838 | 5104 |
| 56 | 2874 | 3082 | 3299 | 3522 | 3753 | 3991 | 4237 | 4490 | 4750 | 5018 | 5293 |
| 58 | 2976 | 3193 | 3416 | 3648 | 3887 | 4134 | 4388 | 4650 | 4920 | 5197 | 5482 |
| 60 | 3079 | 3303 | 3534 | 3774 | 4021 | 4277 | 4540 | 4811 | 5089 | 5376 | 5671 |

BRERETON SOLID LOG TABLE—Continued

ACTUAL CONTENTS OF LOGS OF ROUND TIMBERS IN BOARD FEET

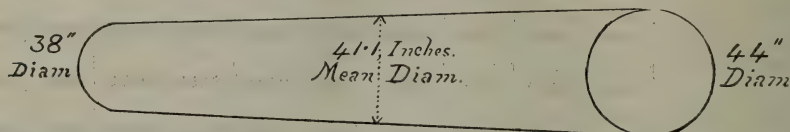
| Length In Feet | Average Diameter in Inches | | | | | | | | | |
|-------------------|----------------------------|------|------|------|------|------|------|------|------|------|
| | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
| 16 | 1593 | 1676 | 1760 | 1847 | 1936 | 2027 | 2121 | 2216 | 2313 | 2413 |
| 18 | 1792 | 1885 | 1980 | 2078 | 2178 | 2281 | 2386 | 2493 | 2602 | 2714 |
| 20 | 1991 | 2094 | 2200 | 2309 | 2420 | 2534 | 2651 | 2770 | 2892 | 3016 |
| 22 | 2190 | 2304 | 2420 | 2540 | 2662 | 2788 | 2916 | 3047 | 3181 | 3318 |
| 24 | 2389 | 2513 | 2641 | 2771 | 2904 | 3041 | 3181 | 3324 | 3470 | 3619 |
| 26 | 2588 | 2723 | 2861 | 3002 | 3146 | 3294 | 3446 | 3601 | 3759 | 3921 |
| 28 | 2787 | 2932 | 3081 | 3233 | 3388 | 3548 | 3711 | 3878 | 4048 | 4222 |
| 30 | 2986 | 3142 | 3301 | 3464 | 3631 | 3801 | 3976 | 4155 | 4337 | 4524 |
| 32 | 3186 | 3351 | 3521 | 3695 | 3873 | 4055 | 4241 | 4432 | 4627 | 4825 |
| 34 | 3385 | 3560 | 3741 | 3925 | 4115 | 4308 | 4506 | 4709 | 4916 | 5127 |
| 36 | 3584 | 3770 | 3961 | 4156 | 4357 | 4562 | 4771 | 4986 | 5204 | 5429 |
| 38 | 3783 | 3979 | 4181 | 4387 | 4599 | 4815 | 5036 | 5263 | 5494 | 5730 |
| 40 | 3982 | 4189 | 4401 | 4618 | 4841 | 5068 | 5301 | 5540 | 5783 | 6032 |
| 42 | 4181 | 4398 | 4621 | 4849 | 5083 | 5322 | 5567 | 5817 | 6072 | 6333 |
| 44 | 4380 | 4608 | 4841 | 5080 | 5325 | 5575 | 5832 | 6094 | 6361 | 6635 |
| 46 | 4579 | 4817 | 5061 | 5311 | 5567 | 5829 | 6097 | 6371 | 6651 | 6937 |
| 48 | 4778 | 5027 | 5281 | 5542 | 5809 | 6082 | 6362 | 6648 | 6940 | 7238 |
| 50 | 4977 | 5236 | 5501 | 5773 | 6051 | 6336 | 6627 | 6925 | 7229 | 7540 |
| 52 | 5177 | 5445 | 5721 | 6004 | 6293 | 6589 | 6892 | 7202 | 7518 | 7841 |
| 54 | 5376 | 5655 | 5941 | 6235 | 6535 | 6842 | 7157 | 7479 | 7807 | 8143 |
| 56 | 5575 | 5864 | 6161 | 6465 | 6777 | 7096 | 7422 | 7756 | 8096 | 8445 |
| 58 | 5774 | 6074 | 6381 | 6696 | 7019 | 7349 | 7687 | 8033 | 8386 | 8746 |
| 60 | 5973 | 6283 | 6601 | 6927 | 7261 | 7603 | 7952 | 8310 | 8675 | 9048 |

TO COMPUTE CONTENTS OF A LOG, ROUND TAPERING TIMBER OR FRUSTUM OF A CONE

To compute the board feet contents of a log, round tapering timber or frustum of a cone.

Rule:

Add together squares of the diameters of the smaller and larger ends and product of the two diameters; multiply their sum respectively by .7854, and this product by length (height); then divide result by 12 and 3.



Example:

Find the board feet contents of a log 38 inches diameter at the small end, and 44 inches diameter at the large end, 40 feet in length.

Process:

| | | |
|---------------------|----------------|-------------|
| (Small diam) | 38 x 38 equals | 1444 |
| (Large diam) | 44 x 44 equals | 1936 |
| (Both diam's) | 38 x 44 equals | 1672 |
| | | <hr/> |
| | | 5052 |
| Sum of diameters by | | .7854 |
| | | <hr/> |
| | | 20208 |
| | | 25260 |
| | | 40416 |
| | | 35364 |
| | | <hr/> |
| | | 3967.8408 |
| Multiplied by | | 40 |
| | | <hr/> |
| Divided by | 12) | 158713.6320 |
| | | <hr/> |
| Divided by | 3) | 13226.1360 |
| | | <hr/> |

4408.7120 Board Feet, Contents

The exact mean diameter of the log in the foregoing example is 41.1 inches, not 41 inches as would be generally supposed. The difference is due to the converging slant height of a tapering body which gives a very slight increase in mean diameter over the approximate diameter which is computed by adding the top and bottom diameter together and dividing by 2.

When the diameter of a round timber is given or the mean diameter of a log is known the board feet contents can be obtained by reference to the Actual Contents Table, or using the following rule.

Rule:

Multiply the square of the diameter by .7854, and the product by the length, then divide by 12.

To compute contents of round timber

Example:

Find the board measure contents of a round timber 20 inches diameter and 50 feet in length.

Process:

| | | |
|--|----------------|-------------------|
| Square of diam. | 20 x 20 equals | 400. |
| 400 multiplied by .7854 equals | | 314.16 |
| 314.16 multiplied by length 50 ft., equals | | 15708 |
| 15708 divided by 12 equals | | 1309, Board Feet. |

COMPUTING CONTENTS OF LOGS BY CIRCUMFERENCE

When the mean circumference of a log or round timber is known, the following rule gives the actual board measure contents.

Rule:

Multiply the square of the circumference by twice the length and divide by 300.

Example:

Find the actual board measure contents of a log 60 inches mean circumference and 50 feet in length.

Process:

60 x 60 equals 3600, the square of the circumference.

3600 x 100, (twice 50, the length,) equals 360,000.

360,000 divided by 300 equals 1200, the board measure contents.

Note:

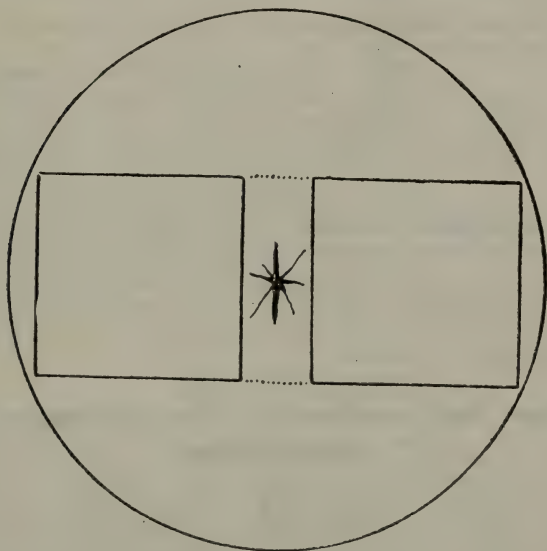
The foregoing rule gives five feet more lumber in every thousand feet a log contains than if computed by the long and tedious rule of geometry and is sufficiently correct for all practical purposes.

The circumference of a log or circle multiplied by 0.31831 will give the diameter.

The diameter multiplied by 3—1/7 or for greater "accuracy" by 3.1416 will give the circumference of a log or circle.

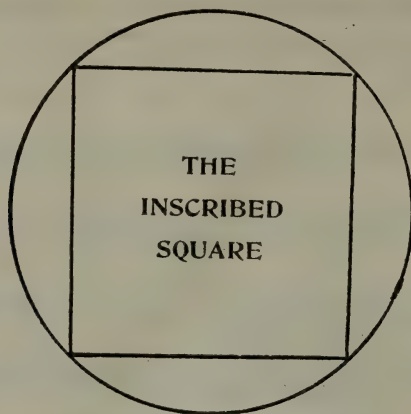
HOW TO SAW TIMBERS

Diagram Illustrating Correct Method of Making Two Timbers Out of a Log



When it is necessary to make two sound timbers out of a large log, splitting through the heart should always be avoided, and if the following system is adopted better timbers will be produced, and the danger of exposing heart shakes will be greatly minimized.

Presume it is necessary to make two 12x12 timbers out of a log 32 inches in diameter. Square up a 12x28½ (the ½ inch allows for two cuts ¼ inch Kerf), then cut the first timber, and if free from heart shakes, turn cant over and saw off 4 inches, and you will then have the second timber on the carriage. If after the first cut, shakey heart or other defects are exposed, without turning cant make another cut of 4 inches, which leaves a 12x12 on the carriage, and a glance will show whether it is suitable or not for required order.



To find the diameter of a log to make a square timber, divide one side of square by .707, or for practical purposes add a cipher to one side of square and divide by 7.

To find the largest size square timber that can be made out of a log, multiply diameter by 7 and divide by 10.

Examples:

What is the diameter of a log that will make a timber 21 inches square.

Process:

$$\begin{array}{r} 21 \\ 10 \\ \hline 7)210 \end{array}$$

30 inches diameter. Answer.

What size timber can be made out of a log 40 inches in diameter?

$$\begin{array}{r} 40 \\ 7 \\ \hline 10)280 \end{array}$$

28 inches square. Answer.

TABLE SHOWING THE DIAMETER OF A LOG NECESSARY TO MAKE A SQUARE TIMBER

| Diameter of log. | Size of Timber. | Diameter of log. | Size of Timber. |
|---------------------|--------------------|---------------------|--------------------|
| 14½ | 10x19 | 34 | 24x24 |
| 16 | 11x11 | 35½ | 25x25 |
| 17 | 12x12 | 37 | 26x26 |
| 18½ | 13x13 | 38½ | 27x27 |
| 20 | 14x14 | 40 | 28x28 |
| 21½ | 15x15 | 41½ | 29x29 |
| 23 | 16x16 | 42½ | 30x30 |
| 24½ | 17x17 | 44 | 31x31 |
| 25½ | 18x18 | 45½ | 32x32 |
| 27 | 19x19 | 47 | 33x33 |
| 28½ | 20x20 | 48½ | 34x34 |
| 30 | 21x21 | 49½ | 35x35 |
| 31½ | 22x22 | 50½ | 36x36 |
| 33 | 23x23 | | |

KNOTS AND HOW THEY ARE CLASSIFIED

DOUGLAS FIR

A Pin Knot does not exceed half inch in diameter.

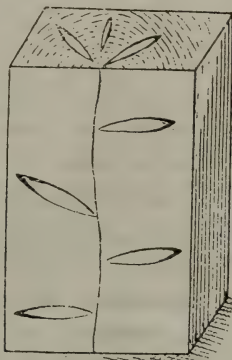
Round Knots are of a circular or oval formation, the average measurement across the face being considered the diameter.

Spike and Slash Knots are the same, and mean that the knot is sawn in a lengthwise direction.

Encased Knots usually are found in upper stock and are recognized by the ring of pitch which surrounds them; the knots on the outside of a plank may be encased, while on the heart side they are solid.

A thorough knowledge of knots is essentially of the utmost importance when grading lumber.

Knots spring from the heart in the same direction as the spokes do from the hub of a wheel.



The above illustration shows a 6 x 12 that has been sawn through the heart; the knots shown are classified as spike or slash.

The majority of knots are black at outside point, and encased about one-third the distance from outside point to the heart center.

The encased knots that penetrate lumber of one inch in thickness are liable to come out when seasoned and then surfaced; the damage is mostly caused by the force of the knife striking and loosening some of the knots as the board passes through the planer.

In lumber two inches and over in thickness, and of number 1 and 2 Merchantable grade, it is only in very rare instances that the knots come out.

Special attention should be paid to the grain surrounding the knots, and the direction it takes, as this indicates more than anything else the strength of the piece.

THE DOYLE RULE

The Doyle Rule is variously known as the Connecticut River Rule, the St. Croix Rule, the Thurber Rule, the Moore and Beeman Rule, and the Scribner Rule—the last name due to the fact that it is now printed in Scribner's Lumber and Log Book. It is used throughout the entire country, and is more widely employed than any other rule. It is constructed by deducting 4 inches from the small diameter of the log as an allowance for slab, squaring one-quarter of the remainder, and multiplying the result by the length of the log in feet.

The important feature of the formula is that the width of slab is always uniform, regardless of the size of the log. This waste allowance is altogether too small for large logs and is excessive for small ones. The principal is mathematically incorrect, for the product of perfect logs of different sizes follows an entirely different mathematical law, and it is, therefore, astonishing that this incorrect rule, which gives wrong results for both large and small logs, should have so general a use.

Where the loss by defects in the timber and waste in milling have accidentally about balanced the inaccuracies of the rule, fairly accurate results have been obtained. Frequently, however, mill men recognize the shortcomings of the rule and make corrections to meet their special requirements. In general, the mill cut overruns the Doyle log scale by about 25 per cent. for short logs 12 to 20 inches in diameter; and for long logs with a small top diameter the overrun is very much higher.

DESCRIPTION OF BRITISH COLUMBIA LOG SCALE

AS AUTHORIZED BY THE BRITISH COLUMBIA GOVERNMENT

Deduct one and a half inches from the mean diameter in inches at the small end of the log.

Square the result and multiply by .7854 to find area.

Deduct three elevenths.

Divide by 12 to bring to board measure and multiply by the length of the log in feet.

The above is intended to apply to all logs whose length is not greater than 40 feet.

It is further provided that in cases of logs over 40 feet in length an allowance on half the length of the log is made, in order to compensate for the increase in diameter; this allowance consists of an increase in the mean diameter at the small end of one inch for each additional 10 feet in length over 40 feet. In other words, in cases of logs from 42 to 50 feet long the contents of half the length of the log are to be computed according to the mean diameter at the small end, the contents of the other half of the log according to a diameter one inch greater than the mean diameter at the small end; in cases of logs from 52 to 60 feet long, the contents of half the log according to the mean diameter at the small end, and those of the other half according to a diameter two inches greater than the mean at the small end, and so on; the contents of the second half to be computed according to a diameter one inch greater than that of the mean at the small end for each additional 10 feet in length after 40 feet.

It was not, however, considered necessary to extend the table for a length of log greater than 40 feet, as the contents of such a log of given diameter may be obtained with sufficient accuracy by adding the tabular contents of half the length of the log at the given diameter to the tabular contents of a similar log at a diameter increased one inch for each additional 10 feet in length beyond 40 feet.

AS PROVIDED UNDER SECTION 6 OF THE "ROYALTY ACT."

Cedar

No. 1.—Logs 16 feet and over in length, 20 inches and over in diameter, that will cut out 50 per cent. or over of their scaled contents in clear inch lumber: Provided that in cases of split timber the foregoing diameter shall not apply as the minimum diameter for this grade.

No. 2.—Shingle grade. Logs not less than 16 inches in diameter and not less than 16 feet in length that are better than No. 3 grade, but not grade No. 1.

No. 3.—Rough logs or tops suitable only for shiplap or dimension.

Culls.—Logs lower in grade than No. 3 shall be classed as culls.

Douglas Fir

No. 1.—Logs suitable for flooring, reasonably straight, not less than 20 feet long, not less than 30 inches in diameter, clear, free from such defects as would impair the value for clear lumber.

No. 2.—Logs not less than 14 inches in diameter, not over 24 feet long or not less than 12 inches in diameter, and over 24 feet, sound, reasonably straight, free from rotten knots or bunch-knots, and the grain straight enough to ensure strength.

No. 3.—Logs having visible defects, such as bad crooks, bad knots, or other defects that would impair the value and lower the grade of lumber below merchantable.

Culls.—Logs lower in grade than No. 3 will be classed as culls.

Spruce, Pine, and Cottonwood

No. 1.—Logs 12 feet and over in length, 30 inches in diameter and over up to 32 feet long, 24 inches if over 32 feet long, reasonably straight, clear, free from such defects as would impair the value of clear lumber.

No. 2.—Logs not less than 14 inches in diameter and not over 24 feet, or not less than 12 inches in diameter and over 24 feet long, sound, reasonably straight, free from rotten knots or bunch-knots, and the grain straight enough to ensure strength.

No. 3.—Logs having visible defects, such as bad crooks, bad knots, or other defects that would lower the grade of lumber below merchantable.

Culls.—Logs lower in grade than No. 3 will be classed as culls.

Diameter measurements, wherever referred to in this Schedule, shall be taken at the small end of the log.

BRITISH COLUMBIA LOG TABLE

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 10 | 43 | 52 | 63 | 74 | 87 | 100 | 114 | 130 | 146 | 163 |
| 12 | 52 | 63 | 76 | 89 | 104 | 120 | 137 | 156 | 175 | 195 |
| 14 | 60 | 73 | 88 | 104 | 121 | 140 | 160 | 181 | 204 | 228 |
| 16 | 69 | 84 | 101 | 119 | 139 | 160 | 183 | 207 | 233 | 261 |
| 18 | 77 | 94 | 113 | 134 | 156 | 180 | 206 | 233 | 262 | 293 |
| 20 | 86 | 105 | 126 | 149 | 174 | 200 | 229 | 259 | 292 | 326 |
| 22 | 95 | 115 | 138 | 164 | 191 | 220 | 252 | 285 | 321 | 358 |
| 24 | 103 | 126 | 151 | 178 | 208 | 240 | 274 | 311 | 350 | 391 |
| 26 | 112 | 136 | 164 | 193 | 226 | 260 | 297 | 337 | 379 | 424 |
| 28 | 120 | 147 | 176 | 208 | 243 | 280 | 320 | 363 | 408 | 456 |
| 30 | 129 | 157 | 189 | 223 | 260 | 300 | 343 | 389 | 437 | 489 |
| 32 | 137 | 168 | 201 | 238 | 278 | 320 | 366 | 415 | 466 | 521 |
| 34 | 146 | 178 | 214 | 253 | 295 | 340 | 389 | 441 | 496 | 554 |
| 36 | 155 | 189 | 227 | 268 | 312 | 360 | 412 | 467 | 525 | 586 |
| 38 | 163 | 199 | 239 | 283 | 330 | 380 | 435 | 492 | 554 | 619 |
| 40 | 172 | 210 | 252 | 297 | 347 | 400 | 457 | 518 | 583 | 652 |

| Length in Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|-----|-----|-----|------|------|------|------|------|------|
| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 10 | 181 | 200 | 220 | 241 | 263 | 286 | 310 | 334 | 360 | 387 |
| 12 | 217 | 240 | 264 | 289 | 315 | 343 | 371 | 401 | 432 | 464 |
| 14 | 253 | 280 | 308 | 337 | 368 | 400 | 433 | 468 | 504 | 541 |
| 16 | 290 | 320 | 352 | 386 | 421 | 457 | 495 | 535 | 576 | 619 |
| 18 | 326 | 360 | 396 | 434 | 473 | 514 | 557 | 602 | 648 | 696 |
| 20 | 362 | 400 | 440 | 482 | 526 | 571 | 619 | 669 | 720 | 773 |
| 22 | 398 | 440 | 484 | 530 | 578 | 629 | 681 | 735 | 792 | 851 |
| 24 | 434 | 480 | 528 | 578 | 631 | 686 | 743 | 802 | 864 | 928 |
| 26 | 471 | 520 | 572 | 626 | 683 | 743 | 805 | 869 | 936 | 1005 |
| 28 | 507 | 560 | 616 | 675 | 736 | 800 | 867 | 936 | 1008 | 1083 |
| 30 | 543 | 600 | 660 | 723 | 789 | 857 | 929 | 1003 | 1080 | 1160 |
| 32 | 579 | 640 | 704 | 771 | 841 | 914 | 990 | 1070 | 1152 | 1237 |
| 34 | 615 | 680 | 748 | 819 | 894 | 971 | 1052 | 1137 | 1224 | 1315 |
| 36 | 652 | 720 | 792 | 868 | 946 | 1029 | 1114 | 1203 | 1296 | 1392 |
| 38 | 688 | 760 | 836 | 916 | 999 | 1086 | 1176 | 1270 | 1368 | 1469 |
| 40 | 724 | 800 | 880 | 964 | 1051 | 1143 | 1238 | 1337 | 1440 | 1547 |

BRITISH COLUMBIA LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length in Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 10 | 414 | 443 | 472 | 503 | 534 | 567 | 600 | 634 | 669 | 706 |
| 12 | 497 | 531 | 567 | 603 | 641 | 680 | 720 | 761 | 803 | 847 |
| 14 | 580 | 620 | 661 | 704 | 748 | 793 | 840 | 888 | 937 | 988 |
| 16 | 663 | 708 | 756 | 804 | 855 | 906 | 960 | 1015 | 1071 | 1129 |
| 18 | 746 | 797 | 850 | 905 | 962 | 1020 | 1080 | 1141 | 1205 | 1270 |
| 20 | 828 | 886 | 945 | 1005 | 1068 | 1133 | 1200 | 1268 | 1340 | 1411 |
| 22 | 911 | 974 | 1039 | 1106 | 1175 | 1246 | 1320 | 1395 | 1473 | 1552 |
| 24 | 994 | 1063 | 1134 | 1207 | 1282 | 1360 | 1440 | 1522 | 1606 | 1693 |
| 26 | 1077 | 1151 | 1228 | 1307 | 1389 | 1473 | 1560 | 1649 | 1740 | 1834 |
| 28 | 1160 | 1240 | 1322 | 1408 | 1496 | 1586 | 1680 | 1776 | 1874 | 1976 |
| 30 | 1243 | 1328 | 1417 | 1508 | 1603 | 1700 | 1800 | 1902 | 2008 | 2117 |
| 32 | 1326 | 1417 | 1511 | 1609 | 1709 | 1813 | 1920 | 2030 | 2142 | 2258 |
| 34 | 1408 | 1506 | 1606 | 1709 | 1816 | 1926 | 2040 | 2156 | 2276 | 2399 |
| 36 | 1491 | 1594 | 1700 | 1810 | 1923 | 2040 | 2160 | 2283 | 2410 | 2540 |
| 38 | 1574 | 1683 | 1795 | 1911 | 2030 | 2153 | 2280 | 2410 | 2544 | 2681 |
| 40 | 1657 | 1771 | 1889 | 2011 | 2137 | 2266 | 2400 | 2537 | 2677 | 2822 |

| Length in Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 10 | 743 | 781 | 820 | 860 | 901 | 943 | 985 | 1029 | 1074 | 1120 |
| 12 | 891 | 937 | 984 | 1031 | 1081 | 1131 | 1183 | 1235 | 1289 | 1344 |
| 14 | 1040 | 1094 | 1148 | 1203 | 1261 | 1320 | 1380 | 1441 | 1504 | 1568 |
| 16 | 1188 | 1249 | 1312 | 1375 | 1441 | 1508 | 1577 | 1647 | 1718 | 1791 |
| 18 | 1337 | 1405 | 1476 | 1547 | 1621 | 1697 | 1774 | 1853 | 1933 | 2015 |
| 20 | 1485 | 1562 | 1640 | 1719 | 1801 | 1885 | 1971 | 2058 | 2148 | 2239 |
| 22 | 1634 | 1718 | 1804 | 1891 | 1982 | 2074 | 2168 | 2264 | 2363 | 2463 |
| 24 | 1782 | 1874 | 1967 | 2063 | 2162 | 2262 | 2365 | 2470 | 2578 | 2687 |
| 26 | 1931 | 2030 | 2131 | 2235 | 2342 | 2451 | 2562 | 2676 | 2792 | 2911 |
| 28 | 2080 | 2186 | 2295 | 2407 | 2522 | 2639 | 2759 | 2882 | 3007 | 3135 |
| 30 | 2228 | 2342 | 2459 | 2579 | 2702 | 2828 | 2956 | 3088 | 3222 | 3359 |
| 32 | 2377 | 2498 | 2623 | 2751 | 2882 | 3016 | 3153 | 3294 | 3437 | 3583 |
| 34 | 2525 | 2655 | 2787 | 2923 | 3062 | 3205 | 3350 | 3499 | 3652 | 3807 |
| 36 | 2674 | 2811 | 2951 | 3094 | 3242 | 3393 | 3548 | 3705 | 3866 | 4031 |
| 38 | 2822 | 2967 | 3115 | 3266 | 3423 | 3582 | 3745 | 3911 | 4081 | 4255 |
| 40 | 2971 | 3123 | 3279 | 3438 | 3603 | 3770 | 3942 | 4117 | 4296 | 4479 |

BRITISH COLUMBIA LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length in Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 10 | 1166 | 1214 | 1262 | 1312 | 1360 | 1414 | 1466 | 1520 | 1574 | 1629 |
| 12 | 1400 | 1457 | 1515 | 1574 | 1632 | 1697 | 1759 | 1823 | 1889 | 1955 |
| 14 | 1633 | 1699 | 1767 | 1837 | 1904 | 1979 | 2053 | 2127 | 2203 | 2281 |
| 16 | 1866 | 1942 | 2020 | 2099 | 2176 | 2262 | 2346 | 2431 | 2518 | 2606 |
| 18 | 2099 | 2185 | 2272 | 2362 | 2448 | 2545 | 2639 | 2735 | 2833 | 2932 |
| 20 | 2333 | 2428 | 2525 | 2624 | 2721 | 2828 | 2932 | 3039 | 3148 | 3258 |
| 22 | 2565 | 2671 | 2777 | 2886 | 2993 | 3110 | 3226 | 3343 | 3462 | 3584 |
| 24 | 2799 | 2913 | 3030 | 3149 | 3265 | 3393 | 3519 | 3647 | 3777 | 3910 |
| 26 | 3032 | 3156 | 3282 | 3411 | 3537 | 3676 | 3812 | 3951 | 4092 | 4235 |
| 28 | 3266 | 3399 | 3535 | 3674 | 3809 | 3959 | 4105 | 4255 | 4407 | 4561 |
| 30 | 3499 | 3642 | 3787 | 3936 | 4081 | 4242 | 4399 | 4559 | 4721 | 4887 |
| 32 | 3732 | 3885 | 4040 | 4198 | 4353 | 4524 | 4692 | 4862 | 5036 | 5213 |
| 34 | 3965 | 4127 | 4292 | 4461 | 4625 | 4807 | 4985 | 5166 | 5351 | 5536 |
| 36 | 4199 | 4370 | 4545 | 4723 | 4897 | 5090 | 5278 | 5470 | 5666 | 5864 |
| 38 | 4432 | 4613 | 4797 | 4986 | 5169 | 5373 | 5572 | 5774 | 5980 | 6190 |
| 40 | 4665 | 4856 | 5050 | 5248 | 5441 | 5655 | 5865 | 6078 | 6295 | 6516 |

| Length in Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 10 | 1685 | 1745 | 1800 | 1859 | 1919 | 1980 | 2042 | 2105 | 2169 | 2233 |
| 12 | 2022 | 2094 | 2160 | 2231 | 2303 | 2376 | 2451 | 2526 | 2603 | 2679 |
| 14 | 2359 | 2443 | 2520 | 2603 | 2687 | 2772 | 2859 | 2947 | 3036 | 3126 |
| 16 | 2696 | 2791 | 2881 | 2975 | 3071 | 3168 | 3267 | 3368 | 3470 | 3672 |
| 18 | 3033 | 3140 | 3241 | 3347 | 3455 | 3565 | 3676 | 3789 | 3904 | 4019 |
| 20 | 3370 | 3489 | 3601 | 3719 | 3839 | 3961 | 4084 | 4210 | 4338 | 4465 |
| 22 | 3707 | 3838 | 3961 | 4091 | 4223 | 4357 | 4493 | 4631 | 4771 | 4912 |
| 24 | 4044 | 4187 | 4321 | 4463 | 4606 | 4753 | 4901 | 5052 | 5205 | 5358 |
| 26 | 4381 | 4536 | 4681 | 4834 | 4990 | 5149 | 5310 | 5473 | 5639 | 5805 |
| 28 | 4718 | 4885 | 5041 | 5206 | 5374 | 5545 | 5718 | 5894 | 6073 | 6251 |
| 30 | 5055 | 5234 | 5401 | 5578 | 5758 | 5941 | 6126 | 6315 | 6506 | 6698 |
| 32 | 5393 | 5583 | 5761 | 5950 | 6142 | 6337 | 6535 | 6736 | 6940 | 7144 |
| 34 | 5730 | 5932 | 6121 | 6322 | 6526 | 6733 | 6943 | 7157 | 7374 | 7591 |
| 36 | 6067 | 6281 | 6481 | 6694 | 6910 | 7129 | 7352 | 7578 | 7808 | 8037 |
| 38 | 6404 | 6630 | 6841 | 7066 | 7293 | 7525 | 7760 | 7999 | 8241 | 8484 |
| 40 | 6741 | 6979 | 7201 | 7437 | 7677 | 7921 | 8169 | 8420 | 8675 | 8930 |

SCRIBNER LOG TABLE

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | |
|------------------|--------------------|-----|-----|-----|-----|-----|-----|------|------|
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 20 | 98 | 122 | 143 | 178 | 198 | 232 | 267 | 300 | 350 |
| 22 | 108 | 134 | 157 | 196 | 218 | 255 | 294 | 330 | 385 |
| 24 | 118 | 146 | 172 | 214 | 238 | 278 | 320 | 360 | 420 |
| 26 | 127 | 159 | 186 | 231 | 257 | 302 | 347 | 390 | 455 |
| 28 | 137 | 171 | 200 | 249 | 277 | 325 | 374 | 420 | 490 |
| 30 | 147 | 183 | 214 | 267 | 297 | 348 | 400 | 450 | 525 |
| 32 | 157 | 195 | 229 | 285 | 317 | 371 | 427 | 480 | 560 |
| 34 | 167 | 207 | 243 | 303 | 337 | 394 | 454 | 510 | 595 |
| 36 | 176 | 220 | 257 | 320 | 356 | 418 | 481 | 540 | 630 |
| 38 | 186 | 232 | 272 | 338 | 376 | 441 | 507 | 570 | 665 |
| 40 | 196 | 244 | 286 | 356 | 396 | 464 | 534 | 600 | 700 |
| 42 | 206 | 256 | 300 | 374 | 416 | 487 | 561 | 630 | 735 |
| 44 | 216 | 268 | 315 | 392 | 436 | 510 | 587 | 660 | 770 |
| 46 | 225 | 281 | 329 | 409 | 455 | 534 | 614 | 690 | 805 |
| 48 | 235 | 293 | 343 | 427 | 475 | 557 | 641 | 720 | 840 |
| 50 | 245 | 305 | 357 | 445 | 495 | 580 | 667 | 750 | 875 |
| 52 | 255 | 317 | 372 | 463 | 515 | 603 | 694 | 780 | 910 |
| 54 | 265 | 329 | 386 | 481 | 535 | 626 | 721 | 810 | 945 |
| 56 | 274 | 342 | 400 | 498 | 554 | 650 | 748 | 840 | 980 |
| 58 | 284 | 354 | 405 | 516 | 574 | 673 | 774 | 870 | 1015 |
| 60 | 294 | 366 | 429 | 534 | 594 | 696 | 801 | 900 | 1050 |
| 62 | 304 | 378 | 443 | 552 | 614 | 719 | 828 | 930 | 1085 |
| 64 | 314 | 390 | 458 | 570 | 634 | 742 | 854 | 960 | 1120 |
| 66 | 323 | 403 | 472 | 587 | 653 | 766 | 881 | 990 | 1155 |
| 68 | 333 | 415 | 486 | 605 | 673 | 789 | 908 | 1020 | 1190 |
| 70 | 343 | 427 | 500 | 623 | 693 | 812 | 934 | 1050 | 1225 |

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 20 | 380 | 418 | 470 | 505 | 573 | 625 | 684 | 728 | 761 | 821 |
| 22 | 418 | 460 | 517 | 555 | 630 | 687 | 752 | 801 | 837 | 903 |
| 24 | 456 | 502 | 564 | 606 | 688 | 750 | 821 | 874 | 913 | 985 |
| 26 | 494 | 543 | 611 | 656 | 745 | 812 | 889 | 946 | 989 | 1067 |
| 28 | 532 | 587 | 658 | 707 | 802 | 875 | 958 | 1019 | 1065 | 1149 |
| 30 | 570 | 627 | 705 | 757 | 859 | 937 | 1026 | 1092 | 1141 | 1231 |
| 32 | 608 | 669 | 752 | 808 | 917 | 1000 | 1094 | 1165 | 1218 | 1314 |
| 34 | 646 | 711 | 799 | 858 | 974 | 1062 | 1162 | 1238 | 1294 | 1396 |
| 36 | 684 | 752 | 846 | 909 | 1031 | 1125 | 1231 | 1310 | 1370 | 1478 |
| 38 | 722 | 794 | 893 | 959 | 1089 | 1187 | 1300 | 1383 | 1446 | 1560 |
| 40 | 760 | 836 | 940 | 1010 | 1146 | 1250 | 1368 | 1456 | 1522 | 1642 |
| 42 | 798 | 878 | 987 | 1060 | 1203 | 1312 | 1436 | 1529 | 1598 | 1724 |
| 44 | 836 | 920 | 1034 | 1111 | 1261 | 1375 | 1505 | 1602 | 1674 | 1806 |
| 46 | 874 | 961 | 1081 | 1161 | 1318 | 1437 | 1572 | 1674 | 1750 | 1888 |
| 48 | 912 | 1003 | 1128 | 1212 | 1375 | 1500 | 1642 | 1747 | 1826 | 1970 |
| 50 | 950 | 1045 | 1175 | 1262 | 1432 | 1562 | 1710 | 1820 | 1902 | 2052 |
| 52 | 988 | 1087 | 1222 | 1313 | 1490 | 1625 | 1778 | 1893 | 1979 | 2135 |
| 54 | 1026 | 1129 | 1269 | 1363 | 1547 | 1687 | 1847 | 1966 | 2055 | 2217 |
| 56 | 1064 | 1170 | 1316 | 1414 | 1604 | 1750 | 1915 | 2038 | 2131 | 2299 |
| 58 | 1102 | 1212 | 1363 | 1464 | 1662 | 1812 | 1984 | 2111 | 2207 | 2381 |
| 60 | 1140 | 1254 | 1410 | 1515 | 1719 | 1875 | 2052 | 2184 | 2283 | 2463 |
| 62 | 1178 | 1296 | 1457 | 1565 | 1776 | 1937 | 2120 | 2257 | 2359 | 2545 |
| 64 | 1216 | 1338 | 1504 | 1616 | 1834 | 2000 | 2189 | 2330 | 2435 | 2627 |
| 66 | 1254 | 1379 | 1551 | 1666 | 1891 | 2062 | 2257 | 2402 | 2511 | 2709 |
| 68 | 1292 | 1421 | 1598 | 1717 | 1948 | 2125 | 2326 | 2475 | 2587 | 2791 |
| 70 | 1330 | 1463 | 1645 | 1767 | 2005 | 2187 | 2394 | 2548 | 2663 | 2873 |

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 20 | 888 | 920 | 980 | 1000 | 1095 | 1152 | 1287 | 1335 | 1400 | 1505 |
| 22 | 977 | 1012 | 1078 | 1100 | 1204 | 1267 | 1416 | 1468 | 1540 | 1655 |
| 24 | 1066 | 1104 | 1176 | 1200 | 1314 | 1382 | 1544 | 1602 | 1680 | 1806 |
| 26 | 1154 | 1196 | 1274 | 1300 | 1423 | 1498 | 1673 | 1735 | 1820 | 1956 |
| 28 | 1243 | 1288 | 1372 | 1400 | 1533 | 1613 | 1802 | 1869 | 1960 | 2107 |
| 30 | 1332 | 1380 | 1470 | 1500 | 1642 | 1728 | 1930 | 2002 | 2100 | 2257 |
| 32 | 1421 | 1472 | 1568 | 1600 | 1752 | 1843 | 2059 | 2136 | 2240 | 2408 |
| 34 | 1510 | 1564 | 1666 | 1700 | 1861 | 1958 | 2188 | 2269 | 2380 | 2558 |
| 36 | 1598 | 1656 | 1764 | 1800 | 1971 | 2074 | 2317 | 2403 | 2520 | 2709 |
| 38 | 1687 | 1748 | 1862 | 1900 | 2080 | 2189 | 2445 | 2536 | 2660 | 2859 |
| 40 | 1776 | 1840 | 1960 | 2000 | 2190 | 2304 | 2574 | 2670 | 2800 | 3010 |
| 42 | 1865 | 1932 | 2058 | 2100 | 2299 | 2419 | 2703 | 2803 | 2940 | 3160 |
| 44 | 1954 | 2024 | 2156 | 2200 | 2409 | 2534 | 2831 | 2937 | 3080 | 3311 |
| 46 | 2042 | 2116 | 2254 | 2300 | 2518 | 2650 | 2960 | 3070 | 3220 | 3461 |
| 48 | 2131 | 2208 | 2352 | 2400 | 2628 | 2765 | 3089 | 3204 | 3360 | 3612 |
| 50 | 2220 | 2300 | 2450 | 2500 | 2737 | 2880 | 3217 | 3337 | 3500 | 3762 |
| 52 | 2309 | 2392 | 2548 | 2600 | 2847 | 2995 | 3346 | 3471 | 3640 | 3913 |
| 54 | 2398 | 2484 | 2646 | 2700 | 2956 | 3110 | 3475 | 3604 | 3780 | 4063 |
| 56 | 2486 | 2576 | 2744 | 2800 | 3066 | 3226 | 3604 | 3738 | 3920 | 4214 |
| 58 | 2575 | 2668 | 2842 | 2900 | 3175 | 3341 | 3732 | 3871 | 4060 | 4364 |
| 60 | 2664 | 2760 | 2940 | 3000 | 3285 | 3456 | 3861 | 4005 | 4200 | 4515 |
| 62 | 2753 | 2852 | 3038 | 3100 | 3394 | 3571 | 3990 | 4138 | 4340 | 4665 |
| 64 | 2842 | 2944 | 3136 | 3200 | 3504 | 3686 | 4118 | 4272 | 4480 | 4816 |
| 66 | 2930 | 3036 | 3234 | 3300 | 3613 | 3802 | 4247 | 4405 | 4620 | 4966 |
| 68 | 3019 | 3128 | 3332 | 3400 | 3723 | 3917 | 4376 | 4538 | 4760 | 5117 |
| 70 | 3108 | 3220 | 3430 | 3500 | 3832 | 4032 | 4504 | 4672 | 4900 | 5267 |

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 20 | 1590 | 1679 | 1745 | 1850 | 1898 | 1983 | 2070 | 2160 | 2246 | 2340 |
| 22 | 1749 | 1847 | 1919 | 2035 | 2088 | 2181 | 2277 | 2376 | 2471 | 2574 |
| 24 | 1908 | 2015 | 2094 | 2220 | 2278 | 2380 | 2484 | 2592 | 2695 | 2808 |
| 26 | 2067 | 2183 | 2268 | 2405 | 2467 | 2578 | 2691 | 2808 | 2920 | 3042 |
| 28 | 2226 | 2351 | 2443 | 2590 | 2657 | 2776 | 2898 | 3024 | 3124 | 3276 |
| 30 | 2385 | 2518 | 2617 | 2775 | 2847 | 2974 | 3105 | 3240 | 3369 | 3510 |
| 32 | 2544 | 2686 | 2792 | 2960 | 3037 | 3173 | 3312 | 3456 | 3594 | 3744 |
| 34 | 2703 | 2854 | 2966 | 3145 | 3227 | 3371 | 3519 | 3672 | 3818 | 3978 |
| 36 | 2862 | 3022 | 3141 | 3330 | 3416 | 3569 | 3726 | 3888 | 4043 | 4212 |
| 38 | 3021 | 3190 | 3315 | 3515 | 3606 | 3768 | 3933 | 4104 | 4267 | 4446 |
| 40 | 3180 | 3358 | 3490 | 3700 | 3796 | 3966 | 4140 | 4320 | 4492 | 4680 |
| 42 | 3339 | 3526 | 3664 | 3885 | 3986 | 4164 | 4347 | 4536 | 4717 | 4914 |
| 44 | 3498 | 3694 | 3839 | 4070 | 4176 | 4363 | 4554 | 4752 | 4941 | 5148 |
| 46 | 3657 | 3862 | 4013 | 4255 | 4365 | 4561 | 4761 | 4968 | 5166 | 5382 |
| 48 | 3816 | 4030 | 4188 | 4440 | 4555 | 4759 | 4968 | 5184 | 5390 | 5616 |
| 50 | 3975 | 4197 | 4362 | 4625 | 4745 | 4957 | 5175 | 5400 | 5615 | 5850 |

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 20 | 2434 | 2530 | 2630 | 2730 | 2832 | 2938 | 3044 | 3154 | 3266 | 3380 |
| 22 | 2677 | 2783 | 2893 | 3003 | 3115 | 3232 | 3348 | 3469 | 3593 | 3718 |
| 24 | 2921 | 3036 | 3156 | 3276 | 3398 | 3526 | 3653 | 3785 | 3919 | 4056 |
| 26 | 3164 | 3289 | 3419 | 3549 | 3682 | 3819 | 3957 | 4100 | 4246 | 4394 |
| 28 | 3408 | 3542 | 3682 | 3822 | 3965 | 4113 | 4262 | 4416 | 4572 | 4732 |
| 30 | 3651 | 3795 | 3945 | 4095 | 4248 | 4407 | 4566 | 4731 | 4899 | 5070 |
| 32 | 3894 | 4048 | 4208 | 4368 | 4531 | 4701 | 4870 | 5046 | 5226 | 5408 |
| 34 | 4138 | 4301 | 4471 | 4641 | 4814 | 4995 | 5175 | 5262 | 5552 | 5746 |
| 36 | 4381 | 4554 | 4734 | 4914 | 5098 | 5288 | 5479 | 5677 | 5879 | 6084 |
| 38 | 4625 | 4807 | 4997 | 5187 | 5381 | 5582 | 5784 | 5993 | 6205 | 6422 |
| 40 | 4868 | 5060 | 5260 | 5460 | 5664 | 5876 | 6088 | 6308 | 6532 | 6760 |
| 42 | 5111 | 5313 | 5523 | 5733 | 5947 | 6170 | 6392 | 6623 | 6859 | 7098 |
| 44 | 5355 | 5566 | 5786 | 6006 | 6230 | 6464 | 6697 | 6939 | 7185 | 7436 |
| 46 | 5598 | 5819 | 6049 | 6279 | 6514 | 6757 | 7001 | 7254 | 7512 | 7774 |
| 48 | 5842 | 6072 | 6312 | 6552 | 6797 | 7051 | 7306 | 7570 | 7838 | 8112 |
| 50 | 6085 | 6325 | 6575 | 6825 | 7080 | 7345 | 7610 | 7885 | 8165 | 8450 |

SCRIBNER LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|-------|-------|-------|-------|-------|
| | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 20 | 3496 | 3614 | 3734 | 3858 | 3982 | 4110 | 4240 | 4374 | 4510 | 4648 |
| 22 | 3846 | 3975 | 4107 | 4244 | 4380 | 4521 | 4664 | 4811 | 4961 | 5113 |
| 24 | 4195 | 4337 | 4481 | 4630 | 4778 | 4932 | 5088 | 5249 | 5412 | 5578 |
| 26 | 4545 | 4698 | 4854 | 5015 | 5177 | 5343 | 5512 | 5686 | 5863 | 6042 |
| 28 | 4894 | 5060 | 5228 | 5401 | 5575 | 5754 | 5936 | 6124 | 6314 | 6507 |
| 30 | 5244 | 5421 | 5601 | 5787 | 5973 | 6165 | 6360 | 6561 | 6765 | 6972 |
| 32 | 5594 | 5782 | 5974 | 6173 | 6371 | 6576 | 6784 | 6998 | 7216 | 7437 |
| 34 | 5943 | 6144 | 6348 | 6559 | 6769 | 6987 | 7208 | 7436 | 7667 | 7902 |
| 36 | 6293 | 6505 | 6721 | 6944 | 7168 | 7398 | 7632 | 7873 | 8118 | 8366 |
| 38 | 6642 | 6867 | 7095 | 7330 | 7566 | 7809 | 8056 | 8311 | 8569 | 8831 |
| 40 | 6992 | 7228 | 7468 | 7716 | 7964 | 8220 | 8480 | 8748 | 9020 | 9296 |
| 42 | 7342 | 7589 | 7841 | 8102 | 8362 | 8631 | 8904 | 9185 | 9471 | 9761 |
| 44 | 7691 | 7951 | 8215 | 8488 | 8760 | 9042 | 9328 | 9622 | 9922 | 10226 |
| 46 | 8041 | 8312 | 8588 | 8874 | 9158 | 9453 | 9752 | 10060 | 10373 | 10791 |
| 48 | 8390 | 8674 | 8962 | 9260 | 9556 | 9864 | 10176 | 10498 | 10824 | 11156 |
| 50 | 8740 | 9035 | 9335 | 9645 | 9955 | 10275 | 10600 | 10935 | 11275 | 11620 |

THE SCRIBNER RULE

This is the oldest log scale now in general use. It was originally published in Scribner's Lumber and Log Book, in later editions of which it was replaced by the Doyle Rule. It is now usually called the "Old Scribner Rule," and is used to some extent in nearly every state. The rule was based on computations derived from diagrams drawn to show the number of inch boards that can be sawed from logs of different sizes after allowing for waste. The contents of these boards was then calculated and the table built up in this way. Sometimes the Scribner Rule is converted into what is known as the Scribner Decimal Rule by dropping the units and rounding the values to the nearest tens. Thus 107 board feet would be written 11 in the Decimal Rule; 104 would be written 10. The Hyslop Rule is practically the same as the Scribner Decimal Rule. The Scribner Rule is known in Minnesota as the Minnesota Standard Rule. In the original table no values were given below a diameter of 12 inches.

In the judgment of most sawyers, the Scribner Rule gives very fair results for small logs cut by circular saws (about 8 gauge), but that for larger logs, about 28 inches, for example, the results are too small. It often happens that defects are greater in large logs than in small ones, because the larger are from older trees, which are more likely to be overmature. Even with these, however, the Scribner Rule is fairly satisfactory if the scaler does not make a further deduction for defects. As a matter of fact, a log rule should make no allowance for defect, because that is unfair to high-grade sound logs; only the scaler should make such allowance. In sound logs the saw cut has been known to overrun the Scribner scale from 10 to 20 per cent.

The Forest Service of the United States Department of Agriculture has adopted the Scribner Decimal Rule for timber sales on the National Forests. It has been in use for about four years and, in the main, has proved satisfactory, since competitive bids enable the buyer to bid higher if the character of the logs indicates a mill overrun.

SPAULDING LOG TABLE

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | |
|------------------|--------------------|-----|-----|-----|-----|-----|-----|-----|------|
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 16 | 77 | 94 | 114 | 137 | 161 | 188 | 216 | 245 | 276 |
| 18 | 87 | 106 | 129 | 154 | 181 | 211 | 243 | 276 | 310 |
| 20 | 96 | 118 | 143 | 171 | 201 | 235 | 270 | 306 | 345 |
| 22 | 106 | 130 | 157 | 188 | 221 | 258 | 297 | 337 | 379 |
| 24 | 116 | 142 | 172 | 206 | 242 | 282 | 324 | 368 | 414 |
| 26 | 125 | 153 | 186 | 223 | 262 | 304 | 360 | 398 | 448 |
| 28 | 134 | 164 | 200 | 240 | 282 | 328 | 378 | 428 | 482 |
| 30 | 144 | 176 | 214 | 257 | 302 | 352 | 404 | 460 | 516 |
| 32 | 154 | 188 | 228 | 274 | 322 | 376 | 432 | 490 | 552 |
| 34 | 164 | 200 | 243 | 291 | 342 | 398 | 458 | 520 | 586 |
| 36 | 174 | 212 | 258 | 308 | 362 | 422 | 486 | 552 | 620 |
| 38 | 183 | 224 | 272 | 325 | 382 | 446 | 512 | 582 | 654 |
| 40 | 192 | 236 | 286 | 342 | 402 | 470 | 540 | 612 | 690 |
| 42 | 202 | 248 | 300 | 359 | 422 | 492 | 566 | 644 | 724 |
| 44 | 212 | 260 | 314 | 376 | 442 | 516 | 596 | 674 | 758 |
| 46 | 222 | 272 | 329 | 394 | 463 | 540 | 620 | 704 | 792 |
| 48 | 232 | 284 | 344 | 412 | 484 | 564 | 648 | 734 | 828 |
| 50 | 241 | 295 | 358 | 429 | 503 | 587 | 674 | 766 | 861 |
| 52 | 250 | 306 | 372 | 446 | 524 | 608 | 720 | 796 | 896 |
| 54 | 259 | 317 | 386 | 463 | 544 | 632 | 728 | 826 | 930 |
| 56 | 268 | 328 | 400 | 480 | 564 | 656 | 764 | 858 | 964 |
| 58 | 278 | 340 | 414 | 497 | 584 | 680 | 782 | 888 | 998 |
| 60 | 288 | 352 | 428 | 514 | 604 | 706 | 808 | 920 | 1032 |

SPAULDING LOG TABLE—Continued CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 16 | 308 | 341 | 376 | 412 | 449 | 488 | 528 | 569 | 612 | 656 |
| 18 | 346 | 384 | 423 | 463 | 505 | 549 | 594 | 640 | 688 | 738 |
| 20 | 385 | 426 | 470 | 515 | 561 | 610 | 660 | 711 | 765 | 820 |
| 22 | 423 | 469 | 517 | 566 | 617 | 671 | 726 | 782 | 841 | 902 |
| 24 | 462 | 512 | 564 | 618 | 674 | 732 | 792 | 854 | 918 | 984 |
| 26 | 500 | 554 | 611 | 668 | 730 | 792 | 858 | 924 | 994 | 1066 |
| 28 | 538 | 596 | 658 | 720 | 786 | 854 | 924 | 996 | 1070 | 1148 |
| 30 | 576 | 640 | 704 | 774 | 842 | 915 | 990 | 1066 | 1146 | 1230 |
| 32 | 616 | 682 | 752 | 824 | 898 | 976 | 1056 | 1138 | 1224 | 1312 |
| 34 | 654 | 724 | 798 | 874 | 954 | 1036 | 1122 | 1208 | 1300 | 1394 |
| 36 | 692 | 768 | 846 | 926 | 1010 | 1098 | 1188 | 1280 | 1376 | 1476 |
| 38 | 730 | 810 | 892 | 978 | 1066 | 1158 | 1254 | 1352 | 1452 | 1558 |
| 40 | 770 | 852 | 940 | 1030 | 1122 | 1220 | 1320 | 1422 | 1530 | 1640 |
| 42 | 808 | 896 | 986 | 1080 | 1178 | 1281 | 1386 | 1493 | 1606 | 1722 |
| 44 | 846 | 938 | 1034 | 1134 | 1234 | 1342 | 1452 | 1565 | 1682 | 1804 |
| 46 | 884 | 980 | 1080 | 1184 | 1290 | 1402 | 1518 | 1636 | 1758 | 1886 |
| 48 | 924 | 1024 | 1128 | 1236 | 1348 | 1464 | 1584 | 1708 | 1836 | 1968 |
| 50 | 961 | 1066 | 1174 | 1289 | 1404 | 1524 | 1650 | 1778 | 1911 | 2050 |
| 52 | 1000 | 1108 | 1220 | 1338 | 1460 | 1584 | 1716 | 1848 | 1988 | 2132 |
| 54 | 1038 | 1151 | 1268 | 1390 | 1516 | 1646 | 1782 | 1920 | 2064 | 2214 |
| 56 | 1076 | 1192 | 1316 | 1440 | 1572 | 1706 | 1838 | 1992 | 2140 | .... |
| 58 | 1114 | 1236 | 1362 | 1494 | 1628 | 1768 | 1914 | 2062 | 2226 | .... |
| 60 | 1152 | 1280 | 1408 | 1548 | 1684 | 1830 | 1980 | 2132 | 2292 | .... |

SPAULDING LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 16 | 701 | 748 | 796 | 845 | 897 | 950 | 1006 | 1064 | 1124 | 1185 |
| 18 | 789 | 841 | 895 | 951 | 1009 | 1069 | 1132 | 1197 | 1264 | 1333 |
| 20 | 876 | 935 | 995 | 1056 | 1121 | 1188 | 1258 | 1330 | 1405 | 1481 |
| 22 | 964 | 1028 | 1094 | 1162 | 1233 | 1307 | 1384 | 1463 | 1545 | 1629 |
| 24 | 1052 | 1122 | 1194 | 1268 | 1346 | 1426 | 1510 | 1596 | 1686 | 1778 |
| 26 | 1139 | 1214 | 1292 | 1372 | 1458 | 1544 | 1634 | 1728 | 1826 | 1926 |
| 28 | 1226 | 1308 | 1392 | 1478 | 1570 | 1662 | 1760 | 1862 | 1966 | 2074 |
| 30 | 1314 | 1402 | 1492 | 1584 | 1682 | 1782 | 1886 | 1994 | 2106 | 2222 |
| 32 | 1402 | 1496 | 1592 | 1690 | 1794 | 1900 | 2012 | 2128 | 2248 | 2370 |
| 34 | 1490 | 1588 | 1690 | 1796 | 1906 | 2020 | 2138 | 2261 | 2388 | 2518 |
| 36 | 1578 | 1682 | 1790 | 1902 | 2018 | 2138 | 2264 | 2394 | 2528 | 2666 |
| 38 | 1664 | 1776 | 1890 | 2006 | 2130 | 2256 | 2390 | 2526 | 2668 | 2814 |
| 40 | 1752 | 1870 | 1990 | 2112 | 2242 | 2376 | 2516 | 2660 | 2810 | 2962 |
| 42 | 1840 | 1963 | 2089 | 2218 | 2354 | 2495 | 2642 | 2793 | 2950 | 3110 |
| 44 | 1928 | 2056 | 2188 | 2324 | 2466 | 2614 | 2768 | 2926 | 3090 | 3258 |
| 46 | 2016 | 2150 | 2288 | 2430 | 2579 | 2732 | 2894 | 3059 | 3230 | 3407 |
| 48 | 2104 | 2244 | 2388 | 2536 | 2692 | 2852 | 3020 | 3192 | 3372 | 3556 |
| 50 | 2190 | 2337 | 2486 | 2640 | 2804 | 2970 | 3144 | 3324 | 3512 | 3704 |

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 16 | 1248 | 1312 | 1377 | 1448 | 1512 | 1581 | 1652 | 1724 | 1797 | 1872 |
| 18 | 1404 | 1476 | 1549 | 1629 | 1701 | 1779 | 1858 | 1939 | 2022 | 2106 |
| 20 | 1560 | 1640 | 1721 | 1810 | 1890 | 1976 | 2065 | 2155 | 2246 | 2340 |
| 22 | 1716 | 1804 | 1893 | 1991 | 2079 | 2174 | 2271 | 2370 | 2470 | 2574 |
| 24 | 1872 | 1968 | 2066 | 2172 | 2268 | 2372 | 2478 | 2586 | 2696 | 2808 |
| 26 | 2028 | 2132 | 2238 | 2352 | 2456 | 2568 | 2684 | 2800 | 2920 | 3044 |
| 28 | 2184 | 2296 | 2410 | 2534 | 2646 | 2766 | 2890 | 3016 | 3144 | 3276 |
| 30 | 2340 | 2460 | 2582 | 2714 | 2834 | 2964 | 3096 | 3232 | 3370 | 3510 |
| 32 | 2496 | 2624 | 2754 | 2896 | 3024 | 3162 | 3304 | 3448 | 3594 | 3744 |
| 34 | 2652 | 2788 | 2926 | 3076 | 3212 | 3360 | 3510 | 3663 | 3819 | 3978 |
| 36 | 2808 | 2952 | 3098 | 3258 | 3402 | 3558 | 3716 | 3879 | 4043 | 4212 |
| 38 | 2964 | 3116 | 3270 | 3439 | 3590 | 3755 | 3923 | 4094 | 4268 | 4446 |
| 40 | 3120 | 3280 | 3442 | 3620 | 3780 | 3952 | 4130 | 4310 | 4492 | 4680 |

SPAULDING LOG TABLE—Continued

CONTENTS OF LOGS IN BOARD FEET

| Length In Ft. | Diameter in Inches | | | | | | | | | |
|------------------|--------------------|------|------|------|------|------|------|------|------|------|
| | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 16 | 1948 | 2025 | 2104 | 2184 | 2266 | 2350 | 2436 | 2524 | 2613 | 2704 |
| 18 | 2191 | 2278 | 2367 | 2457 | 2550 | 2644 | 2740 | 2839 | 2940 | 3042 |
| 20 | 2435 | 2531 | 2630 | 2730 | 2833 | 2938 | 3045 | 3155 | 3266 | 3380 |
| 22 | 2678 | 2784 | 2893 | 3003 | 3116 | 3232 | 3349 | 3470 | 3592 | 3718 |
| 24 | 2922 | 3038 | 3156 | 3276 | 3400 | 3526 | 3654 | 3786 | 3920 | 4056 |
| 26 | 3164 | 3290 | 3418 | 3548 | 3682 | 3818 | 3958 | 4100 | 4246 | 4394 |
| 28 | 3408 | 3544 | 3682 | 3822 | 3966 | 4112 | 4262 | 4416 | 4572 | 4732 |
| 30 | 3652 | 3796 | 3944 | 4094 | 4250 | 4406 | 4566 | 4732 | 4900 | 5070 |
| 32 | 3896 | 4050 | 4203 | 4368 | 4532 | 4700 | 4872 | 5048 | 5226 | 5408 |

SCALING AND GRADING RULES OF THE COLUMBIA RIVER LOG SCALING AND GRADING BUREAU

No. 1 Logs shall be 30 inches and over in diameter inside the bark at the small end and not less than 16 or more than 40 feet in length, and shall, in the judgment of the scaler, be practically suitable for the manufacture of upper grades of lumber.

No. 2 Logs shall be 16 inches and over in diameter inside the bark at the small end and not less than 16 or more than 40 feet in length, and shall, in the judgment of the scaler, be practically suitable for the manufacture of merchantable lumber.

No. 3 Logs shall be 12 inches and over in diameter inside the bark at the small end and not less than 16 or more than 40 feet in length, and shall, in the judgment of the scaler, be practically suitable for the manufacture of inferior grades of lumber.

Cull Logs shall be any logs which in the judgment of the scaler are not practically suitable for manufacture.

All logs to be scaled by the Spaulding Rule.

THE SPAULDING RULE

The Spaulding is the statute rule of California, adopted by an act of the legislature in 1878. It is used also in Oregon, Washington, Utah, and Nevada. It was computed from carefully drawn diagrams of logs from 10 to 96 inches in diameter at the small end. Mill men seem to be well satisfied with its results. It is very similar to the Scribner Rule.

THE INTERNATIONAL METRIC SYSTEM

SYNOPSIS OF THE SYSTEM

The fundamental unit of the metric system is the Meter—the unit of length. From this the units of capacity (Liter) and of weight (Gram) were derived. All other units are the decimal sub-divisions or multiples of these. These three units are simply related; e. g., for all practical purposes one Cubic Decimeter equals one Liter and one Liter of water weighs one Kilogram. The metric tables are formed by combining the words "Meter," "Gram," and "Liter" with the six numerical prefixes, as in the following tables:

| PREFIXES | | MEANING | | UNITS |
|----------|------------------|---------|------|---------------------------|
| milli- | = one thousandth | 1/1000 | .001 | |
| centi- | = one hundredth | 1/100 | .01 | "meter" for length |
| deci- | = one tenth | 1/10 | .1 | |
| Unit | = one | | 1 | "gram" for weight or mass |
| deka- | = ten | 10/1 | 10 | |
| hecto- | = one hundred | 100/1 | 100 | "liter" for capacity |
| kilo- | = one thousand | 1000/1 | 1000 | |

UNITS OF LENGTH

| | | | |
|-------------|---|------|-------|
| milli-meter | = | .001 | meter |
| centi-meter | = | .01 | meter |
| deci-meter | = | .1 | meter |
| METER | = | 1 | meter |
| deka-meter | = | 10 | meter |
| hecto-meter | = | 100 | meter |
| kilo-meter | = | 1000 | meter |

Where miles are used in England and the United States for measuring distances, the kilometer (1,000 meters) is used in metric countries. The kilometer is about 5 furlongs. There are about 1,600 meters in a statute mile, 20 meters in a chain, and 5 meters in a rod.

The meter is used for dry goods, merchandise, engineering construction, building, and other purposes where the yard and foot are used. The meter is about a tenth longer than the yard.

The centimeter and millimeter are used instead of the inch and its fractions in machine construction and similar work. The centimeter, as its name shows, is the hundredth of a meter. It is used in cabinet work, in expressing sizes of paper, books, and many cases where the inch is used. The centimeter is about two-fifths of an inch and the millimeter about one twenty-fifth of an inch. The millimeter is divided for finer work into tenths, hundredths, and thousandths.

If a number of distances in millimeters, meters, and kilometers are to be added, reduction is unnecessary. They are added as dollars, dimes, and cents are now added. For example, "1,050.25 meters" is not read "1 kilometer, 5 dekameters, 2 decimeters, and 5 centimeters," but "one thousand and fifty meters, twenty-five centimeters," just as "\$1,050.25" is read "one thousand and fifty dollars and twenty-five cents."



FIG. 1. COMPARISON SCALE: 10 CENTIMETERS AND 4 INCHES. (ACTUAL SIZE.)

AREA

The table of areas is formed by squaring the length measures, as in our common system. For land measure 10 meters square is called an "Are" (meaning "area".) The side of one are is about 33 feet. The Hectare is 100 meters square, and, as its name indicates, is 100 areas, or about $2\frac{1}{2}$ acres. An acre is about 0.4 hectare. A standard United States quarter section contains almost exactly 64 hectares. A square kilometer contains 100 hectares.

For smaller measures of surface the square meter is used. The square meter is about 20 per cent larger than the square yard. For still smaller surfaces the square centimeter is used. A square inch contains about $6\frac{1}{2}$ square centimeters.

VOLUME

The cubic measures are the cubes of the linear units. The cubic meter (sometimes called the stère, meaning "solid") is the unit of volume. A cubic meter of water weighs a metric ton and is equal to 1 kiloliter. The cubic meter is used in place of the cubic yard and is about 30 per cent larger. This is used for "cuts and fills" in grading land, measuring timber, expressing contents of tanks and reservoirs, flow of rivers, dimensions of stone, tonnage of ships, and other places where the cubic yard and foot are used. The thousandth part of the cubic meter (1 cubic decimeter) is called the Liter.

For very small volumes the cubic centimeter (cc or cm^3) is used. This volume of water weighs a gram, which is the unit of weight or mass. There are about 16 cubic centimeters in a cubic inch. The cubic centimeter is the unit of volume used by chemists as well as in pharmacy, medicine, surgery, and other technical work. One thousand cubic centimeters make 1 liter.

UNITS OF CAPACITY

| | | | |
|--------------|---|------|-------|
| milli-liter | = | .001 | liter |
| centi-liter | = | .01 | liter |
| deci-liter | = | 1 | liter |
| LITER | = | 1 | liter |
| deka-liter | = | 10 | liter |
| hecto-liter | = | 100 | liter |
| kilo-liter | = | 1000 | liter |

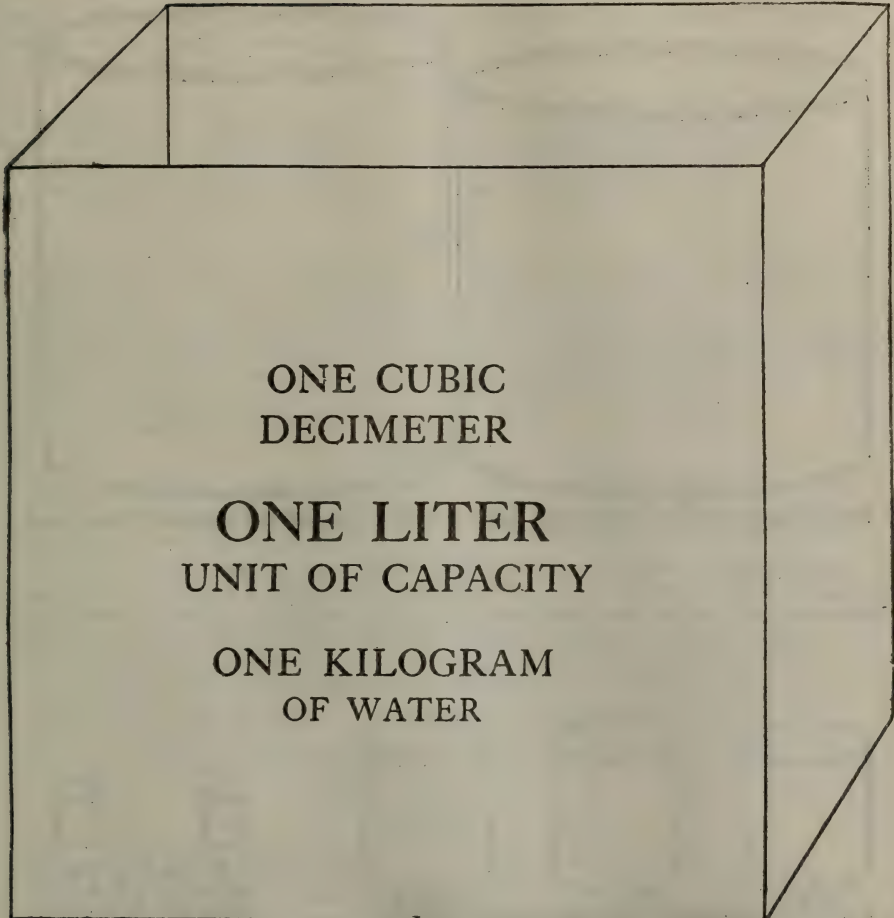


FIG. 2. CUBIC DECIMETER. (ACTUAL SIZE.)

The hectoliter (100 liters) serves the same purposes as the United States bushel (2,150.42 cubic inches), and is equal to about 3 bushels, or a barrel. A peck is about 9 liters. The liter is used for measurements commonly given in the gallon, the liquid and dry quarts, a liter being 5 per cent larger than our liquid quart and 10 per cent smaller than the dry quart. A liter of water weighs exactly a kilogram, i. e., 1,000 grams. A thousand liters of water weigh 1 metric ton.

UNITS OF WEIGHT (OR MASS)

| | | | |
|------------|---|-------|------|
| milli-gram | = | 0.001 | gram |
| centi-gram | = | .01 | gram |
| deci-gram | = | .1 | gram |
| GRAM | = | 1 | gram |
| deka-gram | = | 10 | gram |
| hecto-gram | = | 100 | gram |
| kilo-gram | = | 1000 | gram |

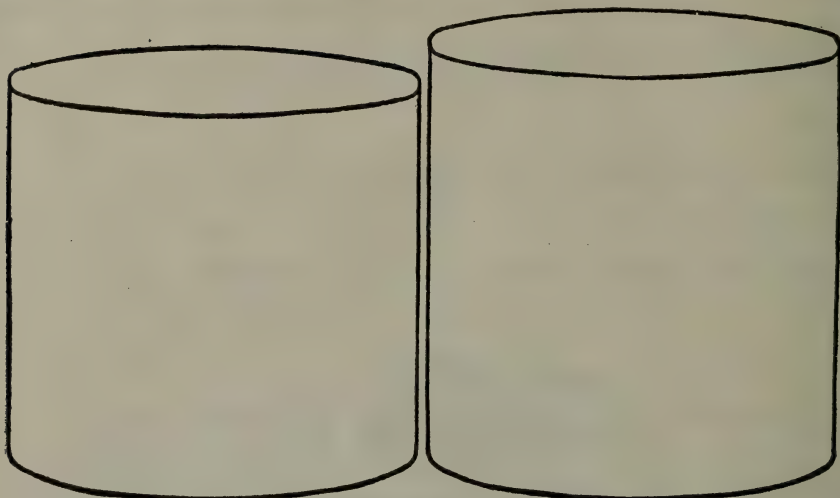


FIG. 3. RELATIVE SIZE OF 2-POUND AND 1-KILOGRAM (BRASS) WEIGHTS. (ACTUAL SIZE.)

Measurements commonly expressed in gross tons or short tons are stated in metric tons (1,000 kilograms). The metric ton comes between our long and short tons and serves the purpose of both. The kilogram and "half kilo" serve for everyday trade, the latter being 10 per cent larger than the pound. The



FIG. 4. RELATIVE SIZE OF AVOIRDUPOIS OUNCE, 30-GRAM, AND TROY OUNCE (BRASS) WEIGHTS. (ACTUAL SIZE.)



FIG. 5. RELATIVE SIZE OF GRAM AND SCRUPLE (BRASS) WEIGHTS. (ACTUAL SIZE.)

kilogram is approximately 2.2 pounds. The gram and its multiples and divisions are used for the same purposes as ounces, pennyweights, drams, scruples, and grains. For foreign postage, 30 grams is the legal equivalent of the avoirdupois ounce.

EQUIVALENTS OF METRIC WEIGHTS AND MEASURES

In the metric system multiples of the units are expressed by the use of the Greek prefix deca, hecto, and kilo, which indicates, respectively, tens, hundreds, and thousands; decimal parts of the unit are expressed by use of the Latin prefix deci, centi, and milli, which indicates, respectively, tenth, hundredth, and thousandth. For all practical purposes 1 cubic decimeter equals 1 liter, and 1 liter of water weighs 1 kilogram or 1 kilo, as it is generally abbreviated. In the tables following are comparisons of the customary and metric units.

LENGTHS

| | |
|---|------------------------------------|
| 1 millimeter (mm.) equals 0.03937 inch. | 1 inch equals 25.4001 millimeters. |
| 1 centimeter (cm.) equals 0.3937 inch. | 1 inch equals 2.54001 centimeters. |
| 1 meter (m) equals 3.28083 feet. | 1 foot equals 0.304801 meter. |
| 1 meter equals 1.093611 yards. | 1 yard equals 0.914402 meter. |
| 1 kilometer (km.) equals 0.62137 mile. | 1 mile equals 1.60935 kilometers. |

AREAS

| | |
|---|---|
| 1 square millimeter equals 0.00155 square inch. | 1 square inch equals 645.16 square millimeters. |
| 1 square centimeter equals 0.155 square inch. | 1 square inch equals 6.452 square centimeters. |
| 1 square meter equals 10.764 square feet. | 1 square foot equals 0.0929 square meter. |
| 1 square meter equals 1.196 square yards. | 1 square yard equals 0.8361 square meter. |
| 1 square kilometer equals 0.3861 square mile. | 1 square mile equals 2.59 square kilometers. |
| 1 hectare equals 2.471 acres. | 1 acre equals 0.4047 hectare. |

VOLUMES

| | |
|---|--|
| 1 cubic centimeter equals 0.061 cubic inch. | 1 cubic inch equals 16.3872 cubic centimeters. |
| 1 cubic meter equals 35.314 cubic feet. | 1 cubic foot equals 0.02832 cubic meter. |
| 1 cubic meter equals 1.3079 cubic yards. | 1 cubic yard equals 0.7645 cubic meter. |

CAPACITIES

| | |
|---|---|
| 1 milliliter (cc.) equals 0.03381 liquid ounce. | 1 liquid ounce equals 29.574 milliliters. |
| 1 milliliter (cc.) equals 0.2705 dram. | 1 dram equals 3.6967 milliliters. |
| 1 milliliter (cc.) equals 0.8115 scruple. | 1 scruple equals 1.2322 milliliters. |
| 1 liter equals 1.05668 liquid quarts. | 1 liquid quart equals 0.94636 liter. |
| 1 liter equals 0.26417 gallon. | 1 gallon equals 3.78543 liters. |
| 1 liter equals 0.9081 dry quart. | 1 dry quart equals 1.1012 liters. |
| 1 liter equals 0.11351 peck. | 1 peck equals 8.80982 liters. |
| 1 dekaliter equals 1.1381 pecks. | 1 peck equals 0.881 dekaliter. |
| 1 hectoliter (hl.) equals 2.83774 bushels. | 1 bushel equals 0.35239 hectoliter. |

MASSSES

| | |
|---|--|
| 1 gram equals 15.4324 grains. | 1 grain equals 0.0648 gram. |
| 1 gram equals 0.03527 avoird. ounce. | 1 avoird. ounce equals 28.3495 grams. |
| 1 gram equals 0.03215 troy ounce. | 1 troy ounce equals 31.10348 grams. |
| 1 kilogram (kg.) equals 2.20462 avoird. pounds. | 1 avoird. pound equals 0.45359 kilogram. |
| 1 kilogram equals 2.67923 troy pounds. | 1 troy pound equals 0.37324 kilogram. |

Note: The unit of lumber measure is called the "Stere" and is equal to the cubic meter.

COMPARISON OF THE VARIOUS POUNDS AND TONS IN USE IN THE UNITED STATES

1 Troy Pound Equals

| | |
|------------|---------------------|
| 0.822857 | Avoirdupois Pounds. |
| 0.37324 | Kilograms. |
| 0.0041143 | Short Tons. |
| 0.00036735 | Long Tons. |
| 0.00037324 | Metric Tons. |

1 Avoirdupois Pound Equals

| | |
|------------|--------------|
| 1.21528 | Troy Pounds. |
| 0.45359 | Kilograms. |
| 0.0005 | Short Tons. |
| 0.00044643 | Long Tons. |
| 0.00045359 | Metric Tons. |

1 Kilogram Equals

| | |
|------------|---------------------|
| 2.67923 | Troy Pounds. |
| 2.20462 | Avoirdupois Pounds. |
| 0.00110231 | Short Tons. |
| 0.00098421 | Long Tons. |
| 0.001 | Metric Tons. |

1 Short Ton Equals

| | |
|---------|---------------------|
| 2430.56 | Troy Pounds. |
| 2000 | Avoirdupois Pounds. |
| 907.18 | Kilograms. |
| 0.89287 | Long Tons. |
| 0.90718 | Metric Tons. |

1 Long Ton Equals

| | |
|---------|---------------------|
| 2722.22 | Troy Pounds. |
| 2240 | Avoirdupois Pounds. |
| 1016.05 | Kilograms. |
| 1.12 | Short Tons. |
| 1.01605 | Metric Tons. |

1 Metric Ton Equals

| | |
|---------|---------------------|
| 2679.23 | Troy Pounds. |
| 2204.62 | Avoirdupois Pounds. |
| 1000 | Kilograms. |
| 1.10231 | Short Tons. |
| 0.98421 | Long Tons. |

Note: A cubic meter of water weighs a metric ton and is equal to one kiloliter. The cubic meter is used in the place of the cubic yard and is about 30 per cent larger.

THE METRIC UNIT OF LUMBER MEASURE

The unit of lumber measure is called the **Stere**, and is equal to the cubic meter.

| | |
|-------------------------|------------------------------|
| 1 Stere (cubic meter) | equals 35.314 Cubic Feet |
| 1 Cubic foot | equals 0.028317 Cubic Steres |
| 1 Stere | equals 0.2759 Cords |
| 1 Cord (128 cubic feet) | equals 3.624 Steres |

The term Stere is from the Greek stereos, meaning solid.

WEIGHT

One Stere or cubic meter of Green Douglas Fir contains 423.7734 Board Feet and weighs approximately 1413 pounds or 636 kilograms.

| | |
|-----------------------------------|----------------------------|
| 1 Metric Ton | equals 0.984206 Long Tons |
| 1 Metric Ton | equals 1.102311 Short Tons |
| 1 Metric Ton | equals 1000 Kilograms |
| 1 Metric Ton | equals 2204.62234 Pounds |
| 1000 Board Feet Green Douglas Fir | weighs 3333 Pounds |
| 1000 Board Feet Green Douglas Fir | weighs 1512 Kilograms |

METHOD USED FOR COMPUTING APPROXIMATE WEIGHT OF FOREIGN EXPORT CARGO SHIPMENTS OF DOUGLAS FIR

| | |
|-----------------|-----------------------|
| 1000 Board Feet | weighs 1½ Long Tons |
| 1000 Board Feet | weighs 1½ Metric Tons |
| 1 Board Foot | weighs 1½ Kilograms |

One St. Petersburg Standard of 165 cubic feet (1980 board feet) weighs 6593 pounds or 2970 kilograms.

HOW TO CUT METRIC LENGTHS

Orders from France and Belgium usually call for lengths of lumber to be cut to the metric foot, which represents the third part of a meter.

The required length is equivalent to $13\frac{1}{4}$ inches. The thickness and width usually correspond to English measure.

French orders contain large amounts of 3x9 of number 1 and 2 Clear grade.

HOW TO FIGURE METRIC ORDERS

To convert Metric to English lengths, multiply by 35 and divide by 32, or to the Metric Feet add one-twelfth and one-eighth of one-twelfth.

How many feet, Board Measure, are contained in the following items of 3x9 cut to Metric Feet?

Process:

| Pcs. | Size | Met. Ft. | Extensions | |
|------|------|----------|----------------|----------------------|
| 60 | 3x9 | 12 | 720 | |
| 114 | 3x9 | 14 | 1,596 | |
| 112 | 3x9 | 16 | 1,792 | |
| 40 | 3x9 | 18 | 720 | |
| 60 | 3x9 | 20 | 1,200 | |
| 386 | | | 6,028 | Metric Lineal Feet |
| | | | 592.33 | |
| | | | 62.79 | |
| | | | 6,593.12 | English Lineal Feet. |
| | | | $2\frac{1}{4}$ | |
| | | | 13,186.24 | |
| | | | 1,648.28 | |
| | | | 14,834.52 | Feet Board Measure. |

The addition of the extensions shows the number of Metric Lineal Feet, the line below shows that amount divided by 12, and this in turn is divided by 8.

The total thus obtained shows the English Lineal Feet. This is brought to Board Measure in the usual way by multiplying by $2\frac{1}{4}$.

TO COMPUTE METRIC DRAFT

French and a number of foreign ships use the metric system, and the draft is painted on the forward and after end of vessel in meters and twentieth parts of a meter, as follows:

The height of figures and distance between figures is uniform, i. e.: each figure is one-tenth of a meter (3.937 inches) in height, and the blank distance between figures is also one-tenth of a meter.

Each advancing meter is indicated by the letter "M" to the right of the numeral.

For example: Presume the draft water line is at the bottom of 60, and the first figure representing the meters above the water line is 4 M, the draft would be 3.60 meters or 11.811 feet (11 ft. 9 $\frac{1}{4}$ in.). If the water line was level with the top of the figure 60, the draft would then be 3.70 meters or 12.139 feet (12 ft. 1 $\frac{1}{4}$ in.).

| |
|----|
| 4M |
| 80 |
| 60 |
| 40 |
| 20 |
| 3M |
| 80 |
| 60 |
| 40 |
| 20 |
| 2M |

TO CONVERT METRIC TO ENGLISH DRAFT**Rule:**

To convert the metric draft to English feet, multiply the meters by 3.281.

Example:

Find the number of English Feet when the draft is 7.20 meters?

Operation:

7.20×3.281 equals 23.6232 feet (23 ft. 7 $\frac{1}{2}$ in.) Multiplying the meters by 105 and dividing by 32 gives the same result.

TO CONVERT ENGLISH TO METRIC DRAFT**Rule:**

To convert English to Metric draft, multiply the feet by 3.048.

Example:

Find the number of Meters, when the English draft in feet is 23 ft. 7 $\frac{1}{2}$ inches (23.6232 feet).

Operation:

23.6232×3.048 equals 7.20035136 Meters.

The same result is obtained by multiplying the English Feet by 32 and dividing by 105.

Example:

Find the numbers of meters, where the English draft is 21 feet.

Operation:

21 multiplied by 32 equals 672; 672 divided by 105 equals 6.40 meters.

USEFUL TABLES FOR CONVERTING DRAFT EQUIVALENTS OF DECIMAL AND BINARY FRACTIONS OF AN INCH IN MILLIMETERS

| Fractions of an Inch. | Millimeters. | Decimals of an Inch. |
|------------------------|--------------|----------------------|
| $\frac{1}{64}$ equals | 0.397 | 0.015625 |
| $\frac{1}{32}$ equals | .794 | .03125 |
| $\frac{1}{16}$ equals | 1.588 | .0625 |
| $\frac{1}{8}$ equals | 3.175 | .1250 |
| $\frac{1}{4}$ equals | 6.350 | .2500 |
| $\frac{1}{2}$ equals | 12.700 | .5 |
| $\frac{1}{100}$ equals | 0.254 | |

| Inches to Millimeters | Millimeters to Inches |
|-----------------------|-----------------------|
| 1 equals 25.4001 | 1 equals 0.03937 |
| 2 equals 50.8001 | 2 equals 0.07874 |
| 3 equals 76.2002 | 3 equals 0.11811 |
| 4 equals 101.6002 | 4 equals 0.15748 |
| 5 equals 127.0003 | 5 equals 0.19685 |
| 6 equals 152.4003 | 6 equals 0.23622 |
| 7 equals 177.8004 | 7 equals 0.27559 |
| 8 equals 203.2004 | 8 equals 0.31496 |
| 9 equals 228.6005 | 9 equals 0.35433 |
| 10 equals 254.0006 | 10 equals 0.39370 |
| 11 equals 279.4006 | 11 equals 0.43307 |
| 12 equals 304.8006 | 12 equals 0.47244 |

CONVERSION TABLES

CONVERSION OF FEET TO METERS

| Feet | Meters | Feet | Meters |
|-------|----------|--------|----------|
| 1 .. | 0.30483 | 51 .. | 15.54483 |
| 2 .. | .60966 | 52 .. | 15.84963 |
| 3 .. | .91440 | 53 .. | 16.15443 |
| 4 .. | 1.21920 | 54 .. | 16.45923 |
| 5 .. | 1.52400 | 55 .. | 16.76403 |
| 6 .. | 1.82880 | 56 .. | 17.06883 |
| 7 .. | 2.13360 | 57 .. | 17.37363 |
| 8 .. | 2.43840 | 58 .. | 17.67844 |
| 9 .. | 2.74321 | 59 .. | 17.98324 |
| 10 .. | 3.04801 | 60 .. | 18.28804 |
| 11 .. | 3.35281 | 61 .. | 18.59284 |
| 12 .. | 3.65761 | 62 .. | 18.89764 |
| 13 .. | 3.96241 | 63 .. | 19.20244 |
| 14 .. | 4.26721 | 64 .. | 19.50724 |
| 15 .. | 4.57201 | 65 .. | 19.81204 |
| 16 .. | 4.87681 | 66 .. | 20.11684 |
| 17 .. | 5.18161 | 67 .. | 20.42164 |
| 18 .. | 5.48641 | 68 .. | 20.72644 |
| 19 .. | 5.79121 | 69 .. | 21.03124 |
| 20 .. | 6.09601 | 70 .. | 21.33604 |
| 21 .. | 6.40081 | 71 .. | 21.64084 |
| 22 .. | 6.70561 | 72 .. | 21.94564 |
| 23 .. | 7.01041 | 73 .. | 22.25044 |
| 24 .. | 7.31521 | 74 .. | 22.55525 |
| 25 .. | 7.62002 | 75 .. | 22.86005 |
| 26 .. | 7.92482 | 76 .. | 23.16485 |
| 27 .. | 8.22962 | 77 .. | 23.46965 |
| 28 .. | 8.53442 | 78 .. | 23.77445 |
| 29 .. | 8.83922 | 79 .. | 24.07925 |
| 30 .. | 9.14402 | 80 .. | 24.38405 |
| 31 .. | 9.44882 | 81 .. | 24.68885 |
| 32 .. | 9.75362 | 82 .. | 24.99365 |
| 33 .. | 10.05842 | 83 .. | 25.29845 |
| 34 .. | 10.36322 | 84 .. | 25.60325 |
| 35 .. | 10.66802 | 85 .. | 25.90805 |
| 36 .. | 10.97282 | 86 .. | 26.21285 |
| 37 .. | 11.27762 | 87 .. | 26.51765 |
| 38 .. | 11.58242 | 88 .. | 26.82245 |
| 39 .. | 11.88722 | 89 .. | 27.12725 |
| 40 .. | 12.19202 | 90 .. | 27.43205 |
| 41 .. | 12.49682 | 91 .. | 27.73686 |
| 42 .. | 12.80163 | 92 .. | 28.04166 |
| 43 .. | 13.10643 | 93 .. | 28.34646 |
| 44 .. | 13.41123 | 94 .. | 28.65126 |
| 45 .. | 13.71603 | 95 .. | 28.95606 |
| 46 .. | 14.02083 | 96 .. | 29.26086 |
| 47 .. | 14.32563 | 97 .. | 29.56566 |
| 48 .. | 14.63043 | 98 .. | 29.87046 |
| 49 .. | 14.93523 | 99 .. | 30.17526 |
| 50 .. | 15.24003 | 100 .. | 30.48006 |

CONVERSION OF METERS TO FEET

| Meters | Feet | Meters | Feet |
|--------|-----------|--------|-----------|
| 1 .. | 3.28083 | 51 .. | 167.32250 |
| 2 .. | 6.56166 | 52 .. | 170.60333 |
| 3 .. | 9.84250 | 53 .. | 173.88417 |
| 4 .. | 13.12333 | 54 .. | 177.16500 |
| 5 .. | 16.40417 | 55 .. | 180.44583 |
| 6 .. | 19.68500 | 56 .. | 183.72667 |
| 7 .. | 22.96583 | 57 .. | 187.00750 |
| 8 .. | 26.24667 | 58 .. | 190.28833 |
| 9 .. | 29.52750 | 59 .. | 193.56917 |
| 10 .. | 32.80833 | 60 .. | 196.85000 |
| 11 .. | 36.08917 | 61 .. | 200.13083 |
| 12 .. | 39.37000 | 62 .. | 203.41167 |
| 13 .. | 42.65083 | 63 .. | 206.69250 |
| 14 .. | 45.93167 | 64 .. | 209.97333 |
| 15 .. | 49.21250 | 65 .. | 213.25417 |
| 16 .. | 52.49333 | 66 .. | 216.53500 |
| 17 .. | 55.77417 | 67 .. | 219.81583 |
| 18 .. | 59.05500 | 68 .. | 223.09667 |
| 19 .. | 62.33583 | 69 .. | 226.37750 |
| 20 .. | 65.61667 | 70 .. | 229.65833 |
| 21 .. | 68.89750 | 71 .. | 232.93917 |
| 22 .. | 72.17833 | 72 .. | 236.22000 |
| 23 .. | 75.45917 | 73 .. | 239.50083 |
| 24 .. | 78.74000 | 74 .. | 242.78167 |
| 25 .. | 82.02083 | 75 .. | 246.06250 |
| 26 .. | 85.30167 | 76 .. | 249.34333 |
| 27 .. | 88.58250 | 77 .. | 252.62417 |
| 28 .. | 91.86333 | 78 .. | 255.90500 |
| 29 .. | 95.14417 | 79 .. | 259.18583 |
| 30 .. | 98.42500 | 80 .. | 262.46667 |
| 31 .. | 101.70583 | 81 .. | 265.74750 |
| 32 .. | 104.98667 | 82 .. | 269.02833 |
| 33 .. | 108.26750 | 83 .. | 272.30917 |
| 34 .. | 111.54833 | 84 .. | 275.59000 |
| 35 .. | 114.82917 | 85 .. | 278.87083 |
| 36 .. | 118.11000 | 86 .. | 282.15167 |
| 37 .. | 121.39083 | 87 .. | 285.43250 |
| 38 .. | 124.67167 | 88 .. | 288.71333 |
| 39 .. | 127.95250 | 89 .. | 291.99417 |
| 40 .. | 131.23333 | 90 .. | 295.27500 |
| 41 .. | 134.51417 | 91 .. | 298.55583 |
| 42 .. | 137.79500 | 92 .. | 301.83667 |
| 43 .. | 141.07583 | 93 .. | 305.11750 |
| 44 .. | 144.35667 | 94 .. | 308.39833 |
| 45 .. | 147.63750 | 95 .. | 311.67917 |
| 46 .. | 150.91833 | 96 .. | 314.96000 |
| 47 .. | 154.19917 | 97 .. | 318.24083 |
| 48 .. | 157.48000 | 98 .. | 321.52167 |
| 49 .. | 160.76083 | 99 .. | 324.80250 |
| 50 .. | 164.04167 | 100 .. | 328.08333 |

U. S. Miles to
Kilometers

| | |
|-------|---------|
| 1 .. | 1.6093 |
| 2 .. | 3.2187 |
| 3 .. | 4.8280 |
| 4 .. | 6.4374 |
| 5 .. | 8.0467 |
| 6 .. | 9.6561 |
| 7 .. | 11.2654 |
| 8 .. | 12.8748 |
| 9 .. | 14.4841 |
| 10 .. | 16.0935 |

Kilometers to
U. S. Miles

| | |
|-------|---------|
| 1 .. | 0.62137 |
| 2 .. | 1.24274 |
| 3 .. | 1.86411 |
| 4 .. | 2.48548 |
| 5 .. | 3.10685 |
| 6 .. | 3.72822 |
| 7 .. | 4.34959 |
| 8 .. | 4.97096 |
| 9 .. | 5.59233 |
| 10 .. | 6.21370 |

Nautical Miles
to Kilometers

| | |
|-------|---------|
| 1 .. | 1.8532 |
| 2 .. | 3.7065 |
| 3 .. | 5.5597 |
| 4 .. | 7.4130 |
| 5 .. | 9.2662 |
| 6 .. | 11.1195 |
| 7 .. | 12.9727 |
| 8 .. | 14.8260 |
| 9 .. | 16.6792 |
| 10 .. | 18.5325 |

Kilometers to
Nautical Miles

| | |
|-------|---------|
| 1 .. | 0.53959 |
| 2 .. | 1.07919 |
| 3 .. | 1.61878 |
| 4 .. | 2.15837 |
| 5 .. | 2.69796 |
| 6 .. | 3.23756 |
| 7 .. | 3.77715 |
| 8 .. | 4.31674 |
| 9 .. | 4.85634 |
| 10 .. | 5.39593 |

METRIC MEASUREMENTS USED IN ITALIAN LUMBER MARKET

The following is an excerpt from The American Lumberman, Chicago, November 23, 1918.

The few cargoes of Spruce from Canada which before the war arrived at Genoa were almost without exception composed entirely of deals in various sizes, as 2x7-inch, — 3x7-inch, — 3x8-inch, — 3x9-inch, — and in various lengths from 10 feet and longer,

The measurements of spruce boards, planks and beams, etc., used in Italy, according to a leading house of lumber importers in Genoa, are as follows:

Small Boards—Thickness, 9 mm. Width, from 120 mm. to 400 mm. (graded), average width being about 250 mm. Length, 4, 4.25, 4.50, 4.75, 5.00 meters.

Boards—Thickness, 14, 18, 24, 28, 34, 44, 48, 54 mm., the greater part in demand averaging 14, 18 and 24 mm. Width and length: As in the foregoing.

Planks—Thickness, 68, 75, 85, 100 mm. Width, 170, 195, 225 mm. Length, 3.50, 3.75, 4.00, 4.50 meters (the greater part averaging 4.50 meters), and up to 10 meters in length, in grades of 25 cm.

Beams, Sawn—Thickness, 150 mm. up to about 400 mm. Length, from 6 meters to 15 meters in grades of 50 cm.

Small Beams, Sawn—Thickness and width, 38x38, 48x48, 58x58, 68x68, 78x78, 88x88, 98x98 mm. Length, 4.00, 4.50, 5.00, 5.50, 6.00 meters, in greater part averaging 4.00, 4.50 and 5.00 meters.

Lath—Thickness and width, 8x25, 28x28, 34x34 mm. Length, 4.00, 4.50 meters. To generalize, the boards and planks mostly used in Italy are of the following sizes:

Thickness—Boards of 14, 18, 24 mm.; to smaller extent boards of 28, 34, 38 and 48 mm., and to a still smaller extent planks of 54, 68, 75, 85 and 100 mm.

Widths—Classified as follows: (1) sottomisura, which contains boards from 100 mm. to 180 mm.; (2) regular widths, which refer to boards and planks from 190 to 400 mm. and up. The average width of boards asked for is 250 mm.

Lengths—The greatest quantity of boards and planks used in Italy are 4 meters to 4.50 meters in length.

The Interpretation of Grades

Mercantile Quality—For the boards of 12, 18, 24, 28 mm. in thickness there is required lumber of what is called in the trade a mercantile quality, by which is understood boards and planks which too perfectly sound may contain knots, provided they are neither too numerous nor too large nor loose.

First Quality—A more choice quality of lumber (first quality) is required for greater thicknesses; that is, for boards and planks of 34, 38, 48, 54, 75, 80 and 100 mm. By first quality lumber is understood boards and planks which are perfectly healthy and which contain only few and small knots. Large and numerous knots are not allowable.

It is also understood that the boards and planks should have the parallel form and should be worked square edged.

Railroad Ties

According to the Government specifications the ties cut from the Italian forests to be accepted must have the following minimum measurements: Length, 2.60 meters; widths, 0.24 meters, and thickness, 0.14 meter.

These measurements must be verified at point of delivery and the supplying firm must therefore allow for natural contraction. As the price of the cross ties is based on number and not on contents no allowance is made the supplier for any extra inherent quantity of lumber over the indicated measurements of the specifications. However, a second dimension is also allowed, as follows: Length, 2.51 meters; width, 0.23 meters, and thickness, 0.135 meters. But the number of cross ties falling short of the measurements of the first specification must not be more than 20 per cent. of the total number of ties accepted.

EXPORTERS SHOULD USE METRIC SYSTEM

Dimension should, so far as possible, be given according to the metric system when negotiating with Italian merchants. In fact, the question of making boards and planks in the sizes required by the Italian market could be advisedly studied. According to some importers, it is more important to conform to the standard measurements of the country than to supply the kinds of lumber known and already used, as the Italian consumers eventually would be fully satisfied with the American woods. The Italians do not understand North American technical phraseology. Quotations for running feet are unintelligible and if the metric system is not used at least quotations should be made in cubic feet, which can without difficulty be translated into cubic meters. Adapting oneself to the market with which one is trading, however, is a thing American lumber manufacturers should learn, and the sooner they accustom themselves to the metric system the better.

Italian lumber importers would, it is understood, be ready to pay cash against documents, on the condition, however, that prices are convenient and provided they have at least a clear idea of the quality of timber which they are to receive. Another practice sometimes adopted is 80 per cent. payment on delivery of document and the balance on actual receipt of parcel or cargo.

PACIFIC LUMBER INSPECTION BUREAU, INC.**HEAD OFFICE**

1011-1014 WHITE BUILDING, SEATTLE, WASH., U. S. A.

F. W. ALEXANDER, MANAGER**L. C. LAURSEN, CHIEF SUPERVISOR****DISTRICT SUPERVISORS**

B. F. Burgess.....539 Finch Bldg.....Aberdeen, Wash.
 R. C. Crakanthorp.....913 Metropolitan Bldg.....Vancouver, B. C.
 A. P. Davies.....1011 White Bldg.....Seattle, Wash.
 H. P. Falt.....North Bend, Ore.
 A. H. Fairchild.....216 Commercial St.....Raymond, Wash.
 Fred T. Hayley.....2 Purcell Bldg.....Everett, Wash.
 A. F. E. Irwin.....P. O. Box 125.....San Pedro, Calif.
 J. S. Kelso.....716 Lewis Bldg.....Portland, Ore.
 I. F. Richardson.....1223 National Realty Bldg. Tacoma, Wash.

PACIFIC COAST GRADING RULES

Owing to the demand for grading rules by the public the Pacific Lumber Inspection Bureau, Inc., find it necessary to make the following charges as specified below. The "lists" can be obtained from any of the district supervisors, or by addressing the head office at Seattle, direct.

Price List**Atlantic Coast List "A"**

Douglas Fir—Western Hemlock—Sitka Spruce and Western Red Cedar
 Grading Rules and Price List.....40 cents
 Grading Rules only.....20 cents

Domestic List Number "7"

Douglas Fir—Western Hemlock—Sitka Spruce—Western Red Cedar and Port
 Orford Cedar.
 Grading Rules and Price List.....40 cents
 Grading Rules only.....20 cents

Export List "H"

Douglas Fir—Western Hemlock—Sitka Spruce.
 Grading Rules and Price List.....40 cents
 Grading Rules only.....20 cents

Grading and dressing rules including diagrams and patterns of the finished sizes of dressed lumber which are recognized as the standard for rail shipments, can be obtained from the following association at 50 cents per copy.

WEST COAST LUMBERMEN'S ASSOCIATION

Henry Bldg., Seattle, Wash., U. S. A.

Lewis Bldg., Portland, Oregon, U. S. A.

LUMBER & SHINGLE MANUFACTURERS, LTD.

Metropolitan Bldg., Vancouver, B. C.

DOUGLAS FIR CAR MATERIAL

Standard specification, grading and dressing rules can be purchased at 10 cents per copy from the **WEST COAST LUMBERMEN'S ASSOCIATION**,
 Seattle, Washington, U. S. A. Portland, Oregon, U. S. A.

Lumbermen engaged in the shipment of Foreign Cargoes, should send for

MISCELLANEOUS SERIES—NO. 67**THE EXPORT LUMBER TRADE OF THE UNITED STATES**

Price, 20 cents

Sold by the Superintendent of Documents,
 Government Printing Office,
 Washington, D. C.

EXCERPT, FROM MISCELLANEOUS SERIES—NO. 67

THE EXPORT LUMBER TRADE OF THE UNITED STATES

By Edward Ewing Pratt

Formerly Chief, Bureau of Foreign and Domestic Commerce, Washington, District of Columbia

It can not be said in general that the American exporters have succeeded in having their grading rules universally recognized abroad. Disputes as to grades are the most serious obstacle to the selling of American lumber in foreign countries.

It is generally considered that the Douglas Fir inspection and grading rules concerning export shipments are the most satisfactory. Some years ago a bureau of inspection was formed, called the Pacific Lumber Inspection Bureau (Inc.), which is a separate establishment from the lumber associations. This bureau employs licensed inspectors and undertakes at a fixed charge per 1,000 feet to inspect cargoes for export. When the cargo has been found "up to grade" the bureau issues an inspection certificate, sworn to before a notary public and countersigned by one of the supervisors of the bureau, certifying to the quantity, character, and condition of the shipment. This certificate is always accepted as proof of the character and condition of the cargo at port of shipment and relieves the shipping mill from any responsibility for impairment of condition during transit. When the exporter has loaded the cargo he presents the inspection certificate to the bank, together with the draft, bill of lading, insurance policy, and other shipping documents. It is understood that these certificates are of the greatest importance in facilitating the discounting of drafts, because the bank's main security is the value of the cargo.

This bureau has been in existence for fifteen years, and its services are considered very valuable and impartial to both importers and exporters. At present the bureau inspects practically all export shipments of Douglas Fir lumber from the Pacific Coast. Last year's report (1916) states that 13,696 inspection certificates were issued and only four complaints were received—two from Europe, one from South America, and one from Australia. One of these complaints was not concerned with grade.

With grades comparatively unknown in many markets, no general custom of branding, and terms often cash before the cargo leaves port, the American lumber trade needs the services of an Inspection Bureau of the highest standard.

The Pacific Lumber Inspection Bureau has been a very important factor in bringing the West Coast lumber trade into foreign markets.

A certificate of inspection is issued by the Pacific Lumber Inspection Bureau in the following form:

PACIFIC LUMBER INSPECTION BUREAU, INC.**LUMBER INSPECTOR'S CERTIFICATE**

We, I, 191.....
..... regularly approved

Lumber Inspector, licensed by the Pacific Lumber Inspection Bureau (Inc.), and at the time acting in that capacity, do hereby certify that we (I) have personally surveyed and inspected, according to the grading and survey rules as per adopted by the West Coast Lumber Manufacturers' Association, the cargo of lumber shipped on board the and the said cargo has been shipped in good order and condition and consists of

Remarks:

Inspector.

Subscribed and sworn to before me, the undersigned, a notary public in and for the by the above-named party, personally known to me as the person signing the above Certificate.

Notary Public.

Countersigned: Supervisor. Dated: 191.....

[This Certificate is not valid unless bearing the seal of the Pacific Lumber Inspection Bureau (Inc.), countersigned by one of its supervisors and free from alterations.]

CALIFORNIA REDWOOD

(*Sequoia Sempervirens*)

DESCRIPTION

Redwood is lumber from the "big trees" of California—the Eighth Wonder of the World. Scientists call them *Sequoia sempervirens*, which, when translated into our every-day tongue, means "Sequoia ever-living." Sequoia is an Indian name; the name of a chief of great power and influence among his people. It was natural, therefore, for the Indians to name the giant trees after their most powerful chief.

They are wonderful trees. Their living power is without peer among perishable and animal life. The secret of their great age is resistance to rot and fire, and practical immunity to the attack of insect life and fungus growth so destructive to most other kinds of wood. In the forests, the Redwoods have fought decay and fire down the sweep of many centuries—they lived on sturdy and strong while other forest trees matured and died in successive crops.

RANGE

By a freak of nature the Redwoods grow nowhere else in the world but in California. Their range is confined to a strip along the Pacific Coast north of San Francisco Bay to the Oregon State line, and extending inland not more than 10 to 20 miles. The principal stand of commercial lumber today is in the three north coast counties of Mendocino, Humboldt and Del Norte. Their growth ranges from the sea level to an altitude of 2500 feet.

YIELD

The Redwoods grow in what is known as the "fog belt," and thrive only in excessive moisture. There are millions of trees, and estimated by the Government to contain between 50,000,000,000 and 60,000,300,000 board measure feet of lumber—more than enough to keep all the saw-mills now cutting Redwood busy day and night for 100 years. The Redwoods grow big and dense, yielding on the average from 75,000 to 100,000 board feet of commercial lumber per acre. There are quite a number of instances where the Redwoods grow so dense and so big that a single acre has yielded more than 1,000,300 board feet of lumber.

CALIFORNIA REDWOOD—Continued

HEIGHT

The Redwood forest is one of the sublimities of nature. The massive trees, with their straight trunks covered with cinnamon-colored bark and fluted from the base to the apex of the tree like a Corinthian column, are as impressive as the cold, silent walls of an ancient cathedral. They grow from 5 to 25 feet in diameter, and from 75 to 300 feet in height. The great size and height of these trees can best be appreciated when it is known that, if hollowed out, one of the large Redwoods would make an elevator shaft for the famous Flatiron Building in New York; in height it would tower 50 feet above the torch of the Statue of Liberty in New York Harbor! They are so large that a single tree has produced enough lumber to build a church at Santa Rosa, California, that will seat 500 people.

The enormous logs make it necessary, to use the most powerful and expensive logging machinery. Many of the large logs must be split with gun-powder before they can be handled on the saw carriage at the mill. It is not uncommon for a butt log (the first cut above the ground) to weigh from 30 to 50 tons, according to the diameter of the tree. The butt cut is usually 16 feet in length.

ROOT FORMATION

One of the strange things about the Redwoods is the root formation, which is slight in comparison with the size of the tree. Redwood actually has an insecure footing. There is no tap root to push straight down into the earth to give the tree stability. The roots radiate a few feet below the surface of the soil. It is supposed they protect themselves by dense growth. The floor of the forest is covered with a luxuriant growth of magnificent ferns and beautiful rhododendrons.

THE BIG TREES OF CALIFORNIA

DESCRIPTION

The *Sequoia gigantea*, or *Sequoia washingtonia*, as the United States Forest Service refer to them, are the "big trees" of the tourist. They are first cousins of the Redwoods. Geologists assert that they are the lone living survivors of all plant and animal life that existed before the glacial age. The few remaining trees are confined to an area of about 50 square miles on the western slope of the Sierra Nevada Mountains, in central California, and of which the Yosemite Valley is a part. Many of these trees are 4000 years of age—and some bold scientists have estimated one to be from 8000 to 10,000 years old! They are located in an altitude of from 4000 to 7000 feet above sea-level, and bear evidence of having passed maturity and are in their decline. If the decline lasts proportionately as long as it took the trees to reach maturity, they are still good for untold centuries. These "big trees" are found only in protected valleys and spots in the mountains, indicating the cause of their survival of the glacial upheaval.

THE GRIZZLY GIANT

The "Grizzly Giant" in Mariposa Grove, Yosemite Park, is 91 feet in circumference at the ground, and its first branch, which is 125 feet from the ground, is 20 feet in circumference. The "General Sherman" is 280 feet high, 103 feet circumference at the ground, which means a diameter of 36½ feet, and at a point 100 feet from the ground it is 17.7 feet in diameter. These are two of the most noted of the "big trees."

The "big trees" of California afford an inexhaustible reservoir of information for the scientist who reads this story of the past by the study of the annular growth. By means of this he is able to determine the season and locate with a degree of definiteness climatic conditions and changes on the Pacific Coast as far back as 4000 years ago!



CALIFORNIA REDWOOD
(*Sequoia Sempervirens*)

SAP

Sap is always white. Some manufacturers make a specialty of turning out a "sappy clear" grade. Lumber of this description shows a streak of white along one edge and presents a most beautiful contrast between the red and white in the wood. This "sappy clear" is highly prized for interior finish.

COLOR AND GRAIN

In color Redwood shades from light cherry to dark mahogany; its grain is straight, fine and even. The color and grain present in combination a handsome appearance. It runs strong to upper grades, and phenomenal widths, sometimes as wide as 36 inches, entirely free from check or other defects.

PAINTING AND POLISHING

Redwood is easily worked, and when properly seasoned it neither swells, shrinks, nor warps—it "stays put," and being free from pitch takes paint well and absorbs it readily. The dark color of the wood makes three coat work necessary, since the priming coat must be mixed extremely thin to fully satisfy the surface. It also takes a beautiful polish, especially if given two coats of shellac and then a wax finish on top.

INTERIOR AND EXTERIOR FINISH

For doors, windows, pattern or panel work, wainscoting, ceiling, casing, shelving, moulding, and every description of interior or exterior finish the finest results can be obtained. For interior finish Redwood should not be painted any more than you would cover oak or mahogany. Redwood's beauty for interior finish lies in its individuality, its soft, warm tone and color possibilities.

QUALITY

Redwood is the most durable of the coniferous woods of California and possesses lasting qualities scarcely equalled by any other timber. Although very light and porous, it has antiseptic properties, which prevent the growth of decay producing fungi. So far as is known, none of the ordinary wood rotting fungi grow in Redwood timber. This is an exceedingly valuable property which should extend the use of this wood for all kinds of construction purposes.

DURABILITY

For tanks, stave water pipe, poles, posts, paving blocks or foundations, it will last almost indefinitely under the trying conditions of being placed in contact with the ground and subject to alternate wet and dry conditions.

For exterior boarding, finish and shingling, whether painted or not, its durability in thousands of instances has been demonstrated to be very great.

PATTERN WORK

Leading engineering and shipbuilding works in California have been using Redwood for pattern work during the past twenty-five years, as it works easily and time has proved that it retains its shape as well as any other wood used for this purpose.

CAR MATERIAL

Redwood is in great demand for all kinds of finish for car material. Its special recommendations for this class of work are its durability and well known fire resisting qualities. Examinations of car siding in use for twenty years have failed to show traces of dry rot or any other form of decay.

The hardest service to which wood can be subjected is the railway tie.

It is not only in constant contact with the ground, but it must stand the strain and stresses of swiftly-moving heavy trains. In his report on "Timber, An Elementary Discussion of the Characteristics and Properties of Wood," to the Division of Forestry, U. S. Department of Agriculture, Filbert Roth, special agent in charge of timber physics, gives the following table on

THE RANGE OF DURABILITY IN RAILROAD TIES

| | | | |
|--|--------|---------------------------------|--------|
| Bedwood | 12 | Elm | 6 to 7 |
| Black Locust | 10 | Long Leaf Pine | 6 |
| Oak (white and chestnut) | 8 | Hemlock | 4 to 6 |
| Chestnut | 8 | Spruce | 5 |
| Tamarack | 7 to 8 | Red and Black Oaks | 4 to 5 |
| Cherry, Black Walnut Locust | 7 | Ash, Beech, Maple | 4 |

To get best service out of the Redwood tie under heavy equipment, tie plates should be used.

Redwood ties are in big demand in South America, England and the continent, Australia and the Orient, because of its resistance to decay and resistance to attack of destructive insects so common in the tropical countries.

HOLDING OF SPIKES

Respecting the "holding of spikes" Redwood ties compare favorably with all other ties ordinarily classed as soft wood.

REDWOOD AND THE TEREDO

The Teredo will attack and destroy Redwood piles or timber as quickly as any other wood.

REDWOOD AND THE WHITE ANT

Owing to its immunity from the ravages of the White Ant, this wood is almost exclusively used in the Philippine Islands for cabinets and boxes to hold important documents.

FIRE RESISTING QUALITIES

Redwood, owing to its freedom from pitch, will not ignite easily nor make a hot fire when burning and is very easily extinguished.

It is an actual fact that fires have been extinguished in Redwood buildings with comparatively slight damage, when the same fire would have made practically a total loss had the buildings been constructed of pine or cedar. The reason is plain. Redwood is not slow in combustion, but absorbs moisture readily and when moistened, resists fire wonderfully.

REDWOOD SHINGLES

Redwood shingles as a roof or side wall covering give long life and fire protection.

No other shingle, or substitute roof covering gives the ideal combination of rot resistance and fire retardance, with the additional merit of being rust proof and free from tar, gum or any other substance to melt in the sun and fill gutters, water pipes or drains.

Always lay Redwood shingles with zinc-coated cut iron nails. This will prolong the life of your roof many years. The ordinary steel shingle nail will rust out while the shingle itself is still in first-class condition. A Redwood shingled roof, laid with the right kind of nails, will give satisfactory service from 30 to 50 years.

You can buy Redwood shingles in two grades, No. 1 Clear and Star A. Star. The former is a carefully selected vertical grain shingle, free from all defects, and is used invariably on coverings where service demands first consideration. The latter is a 10-inch clear butt shingle, "slash" grain being no defect, and it is recommended for side walls rather than for roofing.

In 1893 Redwood shingles were taken from the roof of General U. S. Grant's headquarters, at Fort Humboldt, California, where they had been for 40 years. The wood was absolutely sound and without a trace of rot, although the shingles were worn thin by wind-driven sand.

REDWOOD LATH

Redwood lath have given most satisfactory service for many years, the fire-retarding property of Redwood giving lath of this material a decided advantage over the ordinary kinds. For best results the rough coat of plaster should be allowed to dry thoroughly before applying the finish coat.

GROWS STRONGER WITH AGE

Redwood actually grows stronger with age! This has been demonstrated by tests made at the University of California. Timbers taken from a house built 37 years ago, on the Campus of the University, at Berkeley, were tested and found to be actually stronger than the day when the building was erected. There wasn't the slightest trace of decay in these timbers, and when sawn the wood was virile and healthy in color and texture. Air seasoning had taken place under the most favorable conditions.

The 37-year Redwood had a longitudinal crushing strength one-quarter greater than Redwood which had been air seasoned two years.

WEIGHT OF REDWOOD LOGS

Butt logs absorb so much moisture that the first and second cuts usually sink in water. Left in the sun they require three to four years to dry.

A STRONG WOOD FOR ITS WEIGHT

Seasoned Redwood is one of the strongest woods for its weight. Dry Redwood weighs 26.2 pounds per cubic foot—slightly less than Cypress, which weighs 27.6. It is equal in strength to Cypress, and its breaking strength, according to U. S. Government figures, is 62 per cent of that of White Oak, which is one of the strongest and toughest of American woods.

The standard of lumber weight and measure is based on a "board-measure" foot. A board-measure foot means a piece one inch thick and 12 inches square. One-inch boards, in the rough, dry, weigh 2400 pounds per 1000 board-measure feet. The same boards dressed smooth on two sides would weigh 2000 pounds, and if dressed four sides will weigh 1800 pounds.

WEIGHT OF REDWOOD FOR EXPORT CARGO SHIPMENTS

"Green" Redwood for cargo shipment weighs about 5 pounds per board foot. A simple method for computing the shipping weight is to multiply the board feet by 2.2 per thousand, this gives the weight in tons of 2240 pounds.

The weight in tons of 2240 pounds of seasoned redwood boards is computed by multiplying the board feet by 1.1 per thousand.

Redwood is frequently shipped to Foreign Ports in conjunction with Douglas Fir cargoes. In steamer shipments it is customary to stow "green" Redwood first in lower hold and dry Redwood in the Bridge space, Shelter deck or Tween decks. Douglas Fir is loaded last in the balance of space under deck and on deck. The object of combining Redwood and Douglas Fir cargoes is to balance the weight so as to carry the maximum amount of cargo with a minimum of water ballast.

Under ordinary circumstances a combined cargo with weight of lumber correctly balanced and stowed should only require one third the amount of water ballast that would be necessary with a straight cargo of Douglas Fir.

Redwood immersed in salt water or otherwise exposed to its action will gradually blacken on the surface and for this reason it should not be shipped on deck unless precautions are taken to protect it from the elements.

The exact proportion of green and seasoned redwood and Douglas Fir to obtain the best results cannot be given as so much depends on the specifications type of vessel and intelligent stowage.

The following proportions will give good results under usual circumstances for an ordinary tramp steamer.

| | | |
|-----|----------|---------------|
| 20% | of cargo | Green Redwood |
| 15% | " | Dry Redwood |
| 65% | " | Douglas Fir |

If pickets or lath are not available for stowage, about 5% of cargo in Redwood doorstock would be a good substitute.

CALIFORNIA REDWOOD GRADES

Adopted April 5, 1917 by California Redwood Association
San Francisco, California
Copyright 1917

SPECIAL NOTES

1. All worked lumber shall be measured and invoiced for contents before working.
2. All rough lumber unseasoned shall allow an occasional variation equivalent to 1/16 of an inch in thickness per inch and 1/32 of an inch in width per inch.
3. All rough lumber seasoned shall allow a variation equivalent to 3/32 of an inch in thickness per inch.
4. All rough lumber seasoned shall allow a variation in width as follows:
6-inch and less, 1/4 of an inch in width.
8, 10 and 12 inch, 1/2 of an inch in width.
14-inch and wider, 3/4 of an inch in width.
5. Surfaced lumber will be 1/8 of an inch less for one side and 3/16 of an inch less for two sides. Rustic, T. & G., T. G. & B. will be 3/16 of an inch less for one side and 1/4 of an inch less for two sides. (Above less than rough thickness.)
6. Grain of all grades shall be as the lumber runs.
7. Worked lumber to be in accordance with patterns adopted by California Redwood Association, April 5, 1917.

KNOTS

In these Grading Rules, knots are classified as sound, loose and soft.

A Sound Knot, irrespective of color, is solid across its face, as hard or harder than the wood it is in, and so fixed by growth or position that it will retain its place in the piece.

A Loose Knot is one not held firmly in place by growth or position.

A Soft Knot is one not so hard as the wood itself.

GRADES

Uppers

(Under the heading of Uppers shall be included all Redwood of a grade higher than Extra Merchantable, including Clear, Sap, Select, Standard, Pickets, Battens, etc.)

Clear: Shall be good and sound, free from knots, shakes or splits. Will allow a reasonable amount of birdseye, and sap not exceeding four per cent of the area of all the surfaces. A fair proportion in each shipment may contain pin knots showing on one face only.

Sap Clear: Shall conform generally to the grade of clear, except that it may contain any amount of sap. Discolored sap, when sound, shall not be considered a defect.

CALIFORNIA REDWOOD GRADES—Continued

Select: Shall be good and sound, free from shakes or splits. Shall be graded from the face side and will allow birdseye and one small, sound knot one inch in diameter or its equivalent in each six superficial feet. In the absence of other defects, will allow one soft knot one-half inch in diameter in each six superficial feet. Sap allowed not exceeding four per cent of the area of all the surfaces.

Standard: Shall be graded from the face side, and will allow birdseye, any amount of sap, and in each six superficial feet, two sound knots not exceeding an inch and a quarter in diameter, or their equivalent. In the absence of sound knots, will allow one soft knot one inch in diameter or its equivalent in each six superficial feet.

Clear, Sap Clear and Select Worked: Shall be well manufactured and worked smoothly to uniform thickness. Will admit of slight roughness or variation in milling, and defects mentioned under grades of Clear, Sap Clear and Select.

Standard Worked: Will admit in addition to stock of regular Standard Grade, Clear, Sap Clear, and Select, which, owing to poor machinery, is unsuitable for these grades.

SUNDRY COMMONS

(Under the heading of Sundry Commons shall be included Extra Merchantable, Merchantable, Construction, Shop, etc.)

Extra Merchantable: In one inch shall be free from shakes and splits. Will admit any number of sound knots, but not more than one knot two and a half inches in diameter, in each five superficial feet, and small, soft knots that do not materially affect the strength or usefulness of the board. Will allow sap not exceeding ten per cent of the area of all the surfaces.

In dimension Extra Merchantable shall consist of sound lumber free from shakes, large loose knots, or such other defects as would materially impair its usefulness. Will allow sap not exceeding ten per cent of the area of all the surfaces.

Extra Merchantable Rustic and Shiplap: This grade shall conform to the grade of Extra Merchantable, except that Sap in any amount shall be allowed.

Construction: Shall be suitable for ordinary construction. Will allow sap, loose and soft knots, shakes and other defects, and splits not extending over one-sixth the length of the piece.

Merchantable: This grade is recommended for general building purposes. It consists of sixty per cent Extra Merchantable and not to exceed forty per cent Construction.

Shop: There shall be but one grade in Shop.

Inch Shop: Each piece shall contain not less than fifty per cent of cuttings five inches and wider and three feet and longer, having no defects except sap.

Inch and a Quarter to Two-Inch Shop: Each piece shall contain not less than fifty per cent of two face clear cuttings, exclusive of sap, five inches and wider, and of this fifty per cent of clear cuttings forty per cent shall be suitable for door stiles six feet seven inches and longer.

Two and a Half Inch and Thicker Shop: Shall contain sixty per cent of clear cuttings five inches and wider and two feet and longer.

HOW TO OBTAIN ADDITIONAL INFORMATION REGARDING CALIFORNIA REDWOOD

The California Redwood Association has been organized by the manufacturers of this remarkable lumber for the purpose of supplying the public or prospective buyers with accurate and dependable information about Redwood.

Letters of enquiry will receive prompt and cheerful attention when addressed to the

California Redwood Association
Call Building
San Francisco, Calif., U. S. A.

WESTERN OR SITKA SPRUCE

(*Picca Sitchensis*)

In comparison with other soft woods in the United States that are used for lumber, Western Spruce also known as Sitka and Pacific Spruce, is particularly clean and white, of a soft texture with tough fiber and has a beautiful sheen or glow peculiar to itself.

WESTERN AND EASTERN SPRUCE COMPARED

Comparing Western Spruce with the Spruce of the Eastern States, it bears the same relation that the large tree does to the sapling. The Western Spruce grows very large, the average size of the logs being nearly four feet in diameter, while the average diameter of the Eastern Spruce is less than one foot.

The small tree is fine grained and contains many small red knots, while the larger tree is coarser in grain with a much larger percentage of clear, and what knots occur in the body of the tree are usually black and loose.

USE FOR FINISH

The uses for which Spruce is best adopted are finish, siding, doors, sash, factory work, musical instruments and boxes, especially those for containing pure food products.

Because Spruce is the best substitute for White Pine, now becoming scarce, it is used by sash and door factories in the manufacture of doors, windows, mouldings, frames, etc., and is found to be a very satisfactory wood for these purposes.

BOXES FOR FOOD PRODUCTS

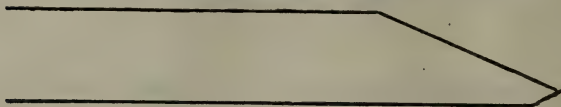
Many of the manufacturers of spruce on the Pacific Coast have box factories and the lower grades are manufactured into box shooks for all purposes. The spruce lumber, however, should be reserved for use in those boxes which are to contain food products, such as crackers, corn starch, butter, dried fruits, etc., because it is so clean, sweet and odorless that it does not taint these substances. It is also largely used for eggs cases to be placed in cold storage, because eggs will taste if packed in boxes made from pine or wood containing pitch. Spruce is used for lining refrigerators for the same reason.

SECRET OF SURFACING

There has been a great deal of complaint on the part of those who have bought and tried to work spruce because it works so hard. The factory man who was used to white pine with its short and brittle grain, has been disappointed because his methods did not bring the same results with spruce. There is but one secret about spruce and the man who knows this can get first class results without special effort. The secret is. to have the wood thoroughly dry and use sharp knives. The fiber of spruce, being long and tough when wet, cuts very hard, but when dry there is no difficulty if the knives are sharp.

SPRUCE—Continued

HOW TO GRIND KNIVES FOR DRESSING SPRUCE



The cut shows the back bevel on the planer knife successfully used by planing mill experts for surfacing "Green" or "Dry" Spruce. When the knife is ground with the bevel as illustrated, it makes a square cut and leaves a smooth surface, as it breaks off the chip instead of tearing it away from the board.

QUALITY

Spruce grades are always good because of the character of the wood. The principal defect is knots and as these are largely black and loose, the wood must be cut up into practically clear lumber. After this is done, the grade is likely to be satisfactory to any buyer.

Spruce has just the right texture to receive and hold paint nicely and is the best known wood for making sign boards, first, because any size and length can be secured, and second, because two coats of paint on spruce will give as good a finish as three coats on almost any other soft wood.

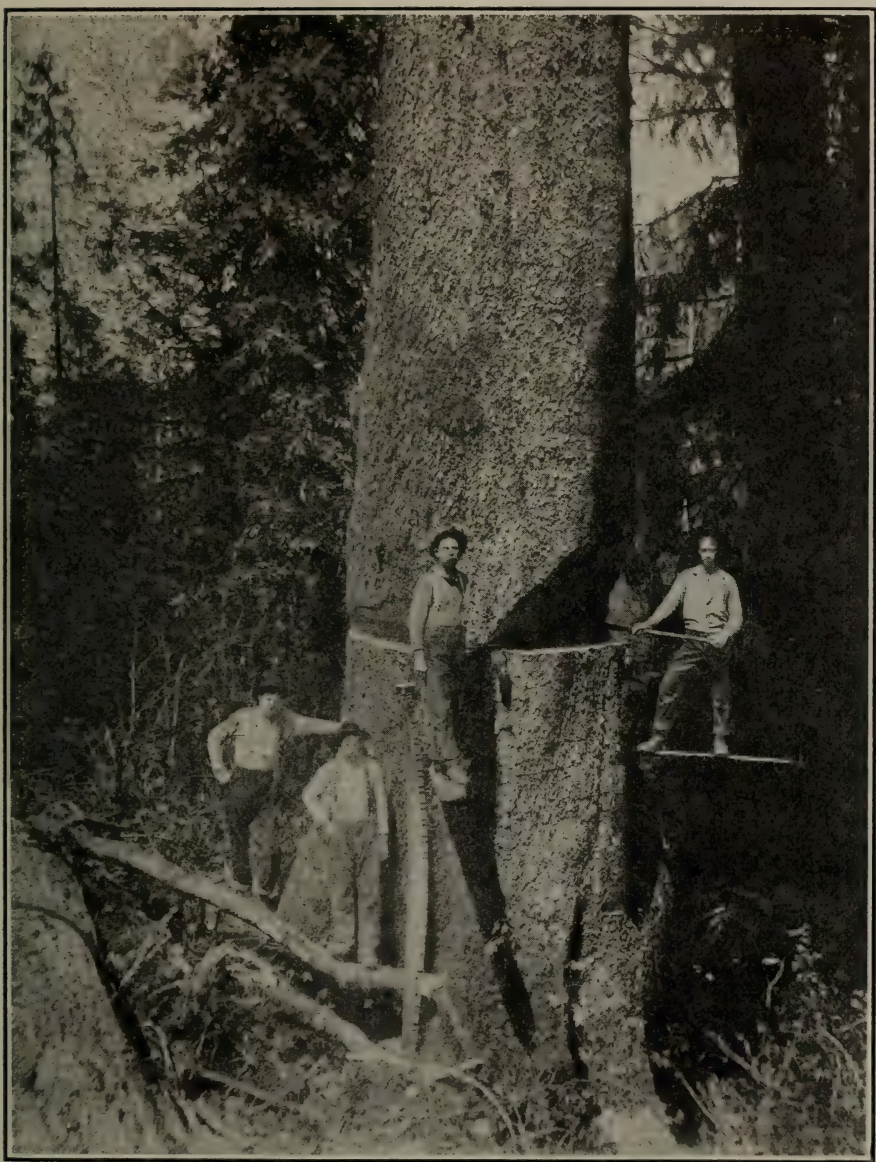
The spruce trees of the Pacific Coast are so large that the percentage of sap is, small, indeed. For this reason spruce does not stain or discolor easily, even if the lumber is placed where it will become mouldy, the blue mould will dress off with a very light cut.

The above statement regarding the spruce of the Pacific Coast will enable the buyer to judge whether it is adapted to his purpose.

SPRUCE FOR AIRPLANES

Western Spruce is the ideal wood for airplane construction it is the toughest softwood for its weight, possesses tremendous shock absorbing qualities, and does not splinter when hit by a missile, it is used in the frames of airplane wings, ailerons, fins, rudders, elevators, and for the stabilizers, the struts, landing gear, fuselage, flooring, engine bed, after-deck, and even the seats are made of it. About 350 pieces of spruce are required in a single airplane, but not all of them are individually different; the wing beams are practically of similar dimensions, and the struts vary only in size according to the strains put upon them.

Roughly, the specifications for spruce parts are: Straight grain, clear from knots and defects so as to give maximum strength. The size of the rough pieces must be such as to insure a finished dimension after deducting losses for finishing, checking and shrinkage. Desirable pieces run $1\frac{1}{4}$ inch to 3 inches thick, 3 inches and upward in width, and from 5 feet to 17 feet in length. Practically all the available spruce is in the United States and along the western coast of British Columbia. In this country, it grows close to the Pacific coast on the western slopes of the Cascade range in the States of Washington and Oregon. The stand of Sitka spruce, which is the best airplane stock, in these two States is estimated at 11,000,000,000 feet. But less than half of it is near enough to transportation facilities, or in dense enough stands to be commercialized.



WESTERN OR SITKA SPRUCE
(*Picea Sitchensis*)

WESTERN HEMLOCK

(*Tsuga Heterophylla*)

The wood of Western Hemlock is light, fairly soft, strong and straight-grained. It is free from pitch or resin. Its strength and ease of working distinguish it from the Eastern Hemlock (*tsuga canadensis* and *tsuga caroliniana*). For ordinary building purposes Western Hemlock is equally as useful as Douglas Fir. It is manufactured into the common forms of lumber, and sold and used for the same purposes as Douglas Fir. It is suitable for inside joists, scantling, lath, siding, flooring and ceiling; in fact, it is especially adapted to uses requiring ease of working, a handsome finish or lightness combined with a large degree of strength. For the manufacture of sash and door stock, fixtures, furniture, turned stock, wainscot and panel it is recognized as a wood of exceptional merit. It is also largely used in the manufacture of boxes and shelving.

The true value of Western Hemlock timber has not been appreciated on account of its name, since it has been confused with the Eastern Hemlock, which produces wood of inferior quality.—“Forest Trees of the Pacific Coast,” by George B. Sudworth.

INTERIOR FINISH

Unlike its Eastern relative, Western Hemlock contains a good proportion of uppers. The clear grades are specially suitable for inside finish, are not easily scratched and when dressed have a smooth surface with a satin sheen, susceptible of a high polish. It will also take enamel finish to perfection, and is well adapted to use as core stock for veneered products. If sawn slash the figure of the grain presents a beautiful effect. The wood is non-resinous and odorless (when dry.)

FLOORING

Vertical Grain Hemlock makes an exceptionally satisfactory flooring. It hardens with age and as a proof of its lasting and wearing qualities the Hemlock floor laid in the Court House of Clatsop County, Oregon, was according to Judge Trenchard in good condition when the building was torn down, after 50 years continual service.

In the Judge's old home, built in 1860, the Hemlock flooring is in excellent condition and so hard that it is now difficult to even drive a tack into it.

BEVEL SIDING

Millions of feet of Clear Western Hemlock are annually manufactured into Bevel Siding. It is a great competitor of Spruce, which it closely resembles, and is often bought or sold as such, either through ignorance or misrepresentation.

USE FOR LIGHT CONSTRUCTION

For sheathing, shiplap, roof or barn boards Western Hemlock is an ideal wood; it is noted for holding nails well, is free from pitch or gum, and the knots in merchantable grades are firm and small. For sanitary reasons it should have a decided preference in the construction of dwelling houses, as it is practically proof against insects, vermin or white ants, and is shunned by rats and mice.

MINING TIMBERS

Entire or part cargoes of Western Hemlock timbers, ties and planks are regularly shipped from the States of Washington and Oregon into California or Mexico, where the lumber is generally used for mining purposes.

PULP WOOD

Many millions of feet of Hemlock are yearly converted into pulp for the making of paper. Practically all of the Hemlock on the Columbia River is used for this purpose by the mills of Oregon City and La Camas.

BOXES AND PACKING CASES

Boxes or Packing Cases manufactured out of Hemlock compare very favorably with other woods used for this purpose. A great number of Hemlock oil cases are shipped to the Orient. One firm in Washington is exporting 50,000 cases per month to Hong Kong and Singapore.

WESTERN HEMLOCK—Continued

WEIGHT

Though Hemlock is very heavy when green, after seasoning it will weigh from 300 to 500 pounds per 1,000 board feet less than Douglas Fir. When paying from 40 to 50 cents per hundred pounds for freight by rail, it means an additional profit that a business man should not lose sight of in cases where the competitive price of other woods is close.

GRADING

The same grading rules that apply to Douglas Fir are generally used for Hemlock.

KILN DRYING

The regular and even structure of the wood and total absence of pitch renders it capable of rapid kiln drying at high temperature without injury.

STRENGTH

The strength of Western Hemlock will be found in the table "Average Strength Values for Structural Timbers" (Page 7).

WESTERN HEMLOCK FOR FOREIGN CARGO SHIPMENT

Buyers and sellers of Western Hemlock will find it to their advantage to act on the following suggestions:

Freshly sawn Hemlock is very heavy and often weighs from four to six pounds per board foot and if shipped in this condition, it displaces more deadweight than Douglas Fir.

The ordinary tramp steamer will carry about ten per cent. more in board feet measurement of Douglas Fir than Hemlock, therefore it would not be good policy to ship a straight cargo of freshly sawn Hemlock.

If Hemlock is shipped in amounts of ten to fifteen per cent. of cargo, it should be a paying proposition if stowed first in lower hold, as the heavy weight in the bottom of the vessel will increase the stability and should cause a reduction of water ballast. This equalizes matters as the extra weight of the Hemlock displaces water ballast upon which no freight is paid.

SIZES BEST ADAPTED FOR CARGO SHIPMENT

The following sizes and lengths can be manufactured to advantage, make good stowage, and can be used with satisfactory results for house construction or similar work.

CLEAR GRADES

1x3 to 1x12—8 to 24 feet long.

2x3 to 2x12—8 to 24 feet long.

MERCHANTABLE GRADES

1x3 to 1x 8—8 to 24 feet long.

2x3 to 2x12—8 to 32 feet long.

3x3 to 3x12—8 to 32 feet long.

4x4 to 4x12—8 to 32 feet long.

SIZES FOR RE-SAWING PURPOSES

It is not advisable to ship Hemlock timbers or sizes of 6 inches in thickness or over, that contain boxed heart, if they are to be used for re-sawing purposes, as Hemlock usually opens up shakey at the heart, and this would cause a loss to the buyer, and result in general dissatisfaction.

WESTERN RED CEDAR

(*Thuja Plicata*)

This cedar is by far the largest of the four true cedars in the world. Since ancient times cedar has been famous for its resistance to decay and its remarkable durability. Western Red Cedar combines these qualities in the highest degree. The wood is exceptionally light, soft, and of close straight grain, making it easy to handle and work. It is free from pitch. Its qualities render it free from warping, shrinking or swelling.

Western Red Cedar is unsurpassed by any other wood where durability, lightness of weight or ease of working are essential. It also is an excellent wood for exterior siding, finish, corrugated decking and porch flooring, battens, porch columns, newels, lath, common boards, flume constructions, drains, canoes, rowboats, trellis-work, hothouse frames and sash, and for all other purposes in which the material used is exposed to the weather or comes in contact with damp soil. Cabinet makers use it for many purposes, including the backs and sides of drawers, shelves, boxes, and partitions.

From Western Red Cedar is made sixty-six per cent of all wooden shingles used in the United States. The red cedar shingle satisfies architecture's basic requirement of combining, utility, durability and beauty.

Western Red Cedar shingles are not a fire-hazard.

The life of a Western Red Cedar shingle roof is determined by the life of the shingle nail used. Such a roof put on with an old-fashioned iron nail coated with pure zinc should last from thirty to forty years. A soft bright wire nail, on the other hand, is sometimes eaten out by the decay-resisting chemicals in the wood so that the life of the roof is greatly shortened. The same applies to the use of the so-called galvanized shingle nail, which, however, may resist the chemical action of the wood for from eight to ten years.

A Western Red Cedar roof will not rot, rust or corrode. Its light weight saves expense in the whole structure of the house. Such a roof is not torn off by wind or storm. It will not require constant up keep and painting. It is noiseless during heavy rain and hail storms. It is a non-conductor of heat and cold. It is easily put on.

RED CEDAR SHINGLES

The standard length of shingles is 16 inches. The expression 6 to 2 and 5 to 2 means that the butt ends of 6 and 5 shingles, respectively, equals 2 inches in measurement. One bunch contains 25 double courses. One double course contains 10 pieces estimated at 4 inches wide. Four bundles are reckoned to the thousand.

One thousand feet log scale will make ten thousand shingles. When shingles are shipped by vessel, freight is usually paid at the rate of 10,000 shingles being equal to 1,000 feet Board Measure.

One thousand shingles can be stowed in a space equal to 10 cubic feet.

To estimate the number of shingles required for a roof when laid 4 inches to the weather, multiply the number of square feet of roof surface by 9.

It is easy to see why the foregoing rule is correct. Each shingle is 4 in. wide and 4 in. only of its length are left exposed, hence it covers 16 sq. inches, or 1/9 of a square foot—9 shingles will cover a square foot.

Estimators usually allow 1,000 shingles to each 100 square feet of roof surface.

To find the number of shingles equal to 1 square foot:

When laid 4 inches to weather, multiply by 9.
 When laid 4½ inches to weather, multiply by 8.
 When laid 5 inches to weather, multiply by 7 1/5.
 When laid 6 inches to weather, multiply by 6.

APPROXIMATE WEIGHT

1000 shingles, kiln dried, weigh 160 pounds.
 1000 shingles, green, weigh 200 to 240 pounds.

To find approximate amount of shingles that can be loaded in a box car, ascertain the capacity of car in cubic feet, add two ciphers to this amount and the result will be the number of shingles required.

HOW TO BUILD A FORTY YEAR ROOF

Much of the following is taken from the American Lumberman Magazine First Prize answer in their International contest "How to Make a Forty-Year Roof."

The first essential is Rite-Grade Red Cedar Shingles. Second, nails, valleys and flashings the equal of good shingles. A roof is only as strong as its weakest part.

For Rafters use sized 2x4s or 2x6s, spaced on not over 2-foot centers, spiked solid and braced as load requires.

For Roof Boards or sheathing use good material, S. I. S. strips 1x4 inches or random widths to not more than 8 inches, spaced not more than two inches apart and nailed solid with 8d nails. Where building paper insulation is used shi lap solid instead of 1x4 inches.

Preparation of Shingles—If they are to be stained use dry shingles, dipping each one in the stain not less than 12 inches from butt. Shingles that are not to be stained should be wet thoroughly before laying. Stained shingles to be wetted before laying (allow time for stain to take full effect).

If additional fire-resistant quality is wanted, dip in good quality of mineral paint or such other approved fire-resistant treatment as may be available.

Shingle Nails—Solid copper, solid zinc, hot-dipped zinc coated or pure iron nails preferred. Where these are not available use old fashioned cut nails.

Size of Nails—For 5 to 2 inches or thinner shingles, 3d; for thicker shingles, 4d.

Laying the Shingles—Start at eaves and lay first course 2-ply, giving first course 1½ inches projection over crown mold and 1-inch projection at gables.

On one-third or more pitch lay 16-inch shingles 4½ inches to the weather; on less than one-third pitch lay 16-inch shingles 4 inches to the weather. On one-third or more pitch lay 18-inch shingles 5½ inches to the weather; on less than one-third pitch lay 18-inch shingles 4½ inches to the weather.

Use a straight edge to make sure courses are laid straight.

Break all joints at least 1¼ inches (sidelap), seeing that no break comes directly over another on any three consecutive courses, thereby covering all nails.

Nail shingles 6 inches from butt (for 4½-inch to weather) and ⅝ to ¾ inch from sides, and put only two nails in each shingle. Slash grain shingles need nails not over 6 inches apart. Shingles wider than 9 inches should be split.

Lay shingles so that water will run with the grain, and do not drive nail heads into shingles.

Lay wet shingles with butts close together. Do not lay shingles dry, unless dipped in non-absorbent paint; then lay ½ inch apart.

Use 14-inch best quality old-style tin, heavily coated, for valleys, or copper. Same for ridge roll.

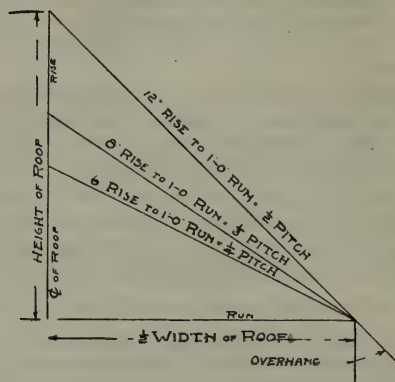
Use heavily coated tin flashing around chimneys.

Finish hips by laying a course of even width narrow shingles on both sides of hip over regular courses.

ROOF PITCHES

This diagram shows the three standard roof pitches that are used by all carpenters who put up buildings. But some good workmen are not sure of all the terms that are used to describe them.

Pitch means the angle or slant of the rafters in a straight line from the eaves to the peak of the roof.



Rise means the vertical elevation of the rafter at a given point. The term "rise" is always used in connection with the term "run." A roof rises a certain number of inches to each foot of the run.

Run is the horizontal measurement from the plate to the center line of the building.

Rise is the vertical climb of the rafter expressed in feet.

For example, the rise of a half pitch roof is equal to the run, which means that the distance from the plate to the center line of the building is the same as the distance from the center line to the peak. The rise of a one-quarter pitch roof is just half as much.

PORT ORFORD CEDAR; LAWSON CYPRESS (*Chamaecyparis Lawsoniana*)

On account of its great beauty as an ornamental evergreen, Lawson Cypress, the Port Orford Cedar of lumbermen, is widely known in this country and abroad. It is little known, however, as a forest tree. It is the largest of its genus and also the largest representative of its tribe (Cupressineae) in North America.

THE WOOD

Port Orford Cedar, also known as White Cedar, is very fine grained, and in color is creamy white, with the slightest tinge of red. The wood has a pleasant rose aromatic odor, which is strong when freshly sawn, but not so pronounced after seasoning. It is a rather hard and firm wood, works as easily as the choicest pine, and is very durable without protection under all sorts of exposure. Experiments have proven that it can be stained to imitate mahogany more closely than any other wood.

It is susceptible to a high polish, and possesses all the features necessary to class it as an excellent material for the better class of interior finish. It is also considered very desirable for airplane material, boat building, shelving, chests and wardrobes where expensive furs and valuable clothes are kept, as its odor is an absolute preventative from the attacks of moths. Its straight grain and the facility with which it is worked gives this wood a high place among those used for match and pattern making.

Nearly all the knots are rotten, in fact in many cases nothing remains but the hole where the knot formerly existed. In spite of this defect, however, the surrounding wood does not decay but is practically everlasting.

FACTORY LUMBER

A large percentage of No. 3 Common would cut up into the best grade of factory lumber, as the knots usually of standard size are wide apart, say at intervals of 4 to 10 feet, and outside of this defect the lumber is clear without blemish.

SHIPPING PORTS

The shipping ports are Coos Bay, and Coquille River, Oregon, consignments destined for the United Kingdom or other Foreign Ports, would probably be re-shipped at San Francisco.

As this wood splits easily, great care should be exercised in the handling to avoid breakages.

WESTERN LARCH (*Larix Occidentalis*)

Western Larch is the largest and most massive of North American Larches. Its straight trunks grow ordinarily to a height of from 100 to 180 feet, and to a diameter of 3 or 4 feet. Not infrequently trees reach a height of over 200 feet and a diameter of from 5 to 8 feet. The tapering trunks are clear of branches for from 60 to 100 feet or more.

DESCRIPTION OF WOOD

The wood is heavy, clear reddish brown, and runs from medium coarse to fine in grain. It is very durable in an unprotected state, differing greatly in this respect from wood of the Eastern Larch.

USE AND DURABILITY

It is used for structural purposes, and is especially valuable for railroad ties, as it holds spikes well, and its durability when in contact with the soil is very great. This wood is manufactured into ceiling, interior finish and moulding and when sawn vertical (edge grain) makes an excellent flooring, as the fiber of the wood wears evenly and smoothly.

Larch takes paint, oil, or stain readily, and with age ripens into a beautiful cherry color.

This lumber is widely known as "Montana Larch," and the growing demand for it is evidence of its increasing popularity with Eastern buyers.

As Western Larch is principally manufactured by Inland Mills, it cannot be profitably shipped in cargo lots to Foreign Countries on account of the extra cost of transportation by car to a shipping port, and the competition of other Coast woods.

NOBLE FIR

(Abies Nobilis)

Of all true firs, Noble Fir is considered the most valuable. In the deep forests which it inhabits, it is, when at its best, one of the most magnificently tall and symmetrically formed trees of its kind. The remarkably straight, even and only slightly tapering trunks are often clear of branches for 100 feet or more. Large trees are from 140 to 200 feet in height, or exceptionally somewhat taller, and from 30 to 60 inches in diameter; trees 6 to 7 feet in diameter occur, but they are rare.

RANGE

Noble Fir grows chiefly on the western slope of the Cascade Mountains, at elevations of from 2,000 to 5,000 feet, from Mount Baker in Northern Washington to the Siskiyou Mountains in Southern Oregon. It also occurs in the Olympic Mountains and in the coast ranges of Western Washington.

Though uncommon on the eastern slope of the Cascade Range, it is very abundant on the Western slope in the vicinity of the Columbia River in Oregon.

In Multnomah County, Oregon, near Bridal Veil, there are about six to eight thousand acres which are estimated to contain over 150 million board feet of Noble Fir, which is standing in a body of 15,000 acres, the balance of the stand being principally old growth Douglas Fir.

Noble Fir is abundant on Mount Rainier at elevations of 4,000 to 5,000 feet, and noted near Ashford at 3,500 feet.

COLOR AND GRAIN

The wood is of a creamy white color, irregularly marked with reddish brown areas, which adds much to its beauty. It is moderately hard, strong, firm, medium close grain, and compact. It is free from pitch, is of soft texture, but hard fiber and when dressed shows a peculiar satin sheen. In quality it is entirely different from and superior to any of the light, very soft fir woods. When seasoned this wood so closely resembles Western Hemlock that it is almost impossible to distinguish between the two when thoroughly dry.

FINISH

It is one of the best woods known for interior or exterior finish, siding, mouldings, sash and doors, and factory work for it retains its shape and "holds its place" well.

FLOORING

On account of the hard fiber, when sawn vertical (edge) grain, it makes a very satisfactory flooring, for it is close grained and presents a hard wearing surface.

GENERAL QUALITY

As the amount of surface clear cut from Noble Fir logs, generally runs from 60 to 80 per cent., the merchantable or common grades are consequently proportionately small.

The smaller trees are fine grained and sound knotted, the knots being firm and red, and interwoven with the fiber of the surrounding wood. For this reason an excellent "board" is the result, for stock boards, for barns, and other purposes where good sound common boards are wanted. This lumber holds a nail well, and produces good merchantable piece stuff such as studs, joists, planks, timbers, and ties.

In the butt cut of larger trees, the knots are often black and loose and lumber cut from this class of log produces a fine grade of "cut up" material.

The wood is odorless, tasteless and non-resinous, making boxes fit for butter, and other articles which would taint from contact with some other kind of woods.

WEIGHT

While the wet, green lumber is heavy—much heavier than Douglas Fir, it dries out so that it ships considerably lighter.

GRAND FIR—WHITE FIR

Grand Fir (*Abies Grandis*) is a closely allied variety of White Fir (*Abies Concolas*) therefore, for all practical purposes, a description of one serves for both.

WHITE FIR (Abies Concolor)

White Fir is a massive tree and generally averages from 140 to 200 feet in height, with a diameter of 40 to 60 inches.

WEIGHT

When green the lumber is very heavy, and butt logs often sink in water. The wood naturally contains a large percentage of moisture, but after a thorough seasoning boards one inch in thickness will weigh about 2,000 pounds to 1,000 board feet.

THE WOOD

The wood is soft, straight grained and works easily. It is only used or suitable for a light class of construction work or temporary mining purposes. In color it is whitish-gray to light indistinct brown. The sawn product closely resembles Hemlock in appearance, but it is inferior to it for finish or construction. White Fir should on no account be classed or confused with Douglas Fir (*Pseudotsuga Taxifolia*) which botanically is not a Fir, and the wood of which is entirely different and vastly superior to that of the White Fir.

OUTPUT

More than half of the total output of White Fir is supplied by California, and approximately 10 per cent. each by Washington, Idaho and Oregon. Small quantities are produced in Montana, Colorado and other Rocky Mountain States.

ITS USE FOR PULPWOOD

Experiments conducted at the Forest Service laboratory at Washington show that this wood is admirably adapted for the production of paper pulp by the sulphite process. The wood is found to yield very readily to the action of the sulphite liquor used, which is of the usual commercial strength, viz., about 4.0 per cent total sulphur dioxide, 1.0 per cent combined and 3.0 per cent available. The length of treatment has varied in the different tests from eight to ten hours, and the steam pressure from 60 to 75 pounds. These pressures correspond to maximum temperatures of 153 to 160 degrees C.

The pulp produced in these experiments is from nearly white to light-brown in color, according to the variations in the method of cooking, and by selecting the proper conditions of treatment, it would be readily possible to produce a grade of fiber which could be used in many kinds of paper without the least bleaching. If, however, it is desired to employ the fiber for white book or writing papers, it could be readily bleached to a good white color. Results of laboratory tests show that the bleach required to bring the fiber up to the usual color for bleached sulphite spruce fiber is from 15 to 23 per cent to the weight of unbleached fiber; that is, assuming the bleaching powder to contain 35 per cent available chloride. Sulphite spruce fiber now on the market requires from 175 to 500 pounds of 35 per cent bleach per ton of product or from 9 to 24 per cent of the unbleached fiber. It is seen, therefore, that so far as bleaching is concerned, the pulp made from white fir is just as good as that made from spruce.

The yields obtained in these experiments ranged from 43 to 49 per cent on the bone-dry basis. This is exclusive of screenings, which in no case exceed 1¼ per cent of the dry wood used. From careful observation of the methods employed in determining the yields, it seems probable that those figures will be increased slightly when larger quantities of wood are used, and it is believed that in the matter of yield the Fir wood is fully equal to spruce.

The fiber from these cooks is in most cases light colored and somewhat lustrous, and the sheets formed from it without any beating are remarkably tough and strong. Microscopic examination and measurements show that the fibers are of very remarkable length, being from one-half to two-thirds as long again as the commercial sulphite spruce fiber.

It is believed from the results that, so far as the product is concerned, the manufacture of fiber from white fir would be a commercial success, and that the fiber produced would find its greatest usefulness in the production of manilas where great strength is required, and in tissues which need very long fibers. It seems probable, also, that it would make very good newspaper, for which purpose its naturally light color would particularly adapt it.

AUSTRALIAN CURRENCY WEIGHTS AND MEASURES

Currency

The currency of Australia is the same as that of Great Britain. The monetary unit is the pound sterling (£), equal to \$4.8665 United States currency. One pound contains 20 shillings. One shilling (s.) equals 12 pence, or $24\frac{1}{4}$ cents United States currency. One penny (d.) equals 2 cents United States currency.

Weights and Measures

The weights and measures of Australia with a few exceptions are the same as those in use in the United States, some of the exceptions being as follows:

| | |
|------------------------------|-------------------------------------|
| 1 imperial gallon | =1.2009 United States gallons. |
| 1 ale and beer gallon | =1.2208 United States gallons. |
| 1 proof gallon | =1.374 United States proof gallons. |
| 1 hundredweight (cwt.) | =112 pounds avoirdupois. |
| 1 ton | =2,240 pounds avoirdupois. |

DUTIES ON LUMBER

DUTIES ON LUMBER ENTERING THE COMMONWEALTH OF AUSTRALIA

| | Per 100 bd. ft. |
|---|--------------------|
| New Zealand white pine and rimu, undressed, n. e. i. | 1s. 0d. |
| Timber, undressed, n. e. i., in sizes of 6x12 inches (or its equivalent) and over | 1s. 0d. |
| Timber, undressed, n. e. i., in sizes of $2\frac{1}{2}$ x7 inches (or its equivalent) and upwards and less than 6x12 inches (or its equivalent) | 3s. 0d. |
| Timber, undressed, n. e. i., in sizes less than $2\frac{1}{2}$ x7 inches (or its equivalent) | 3s. 6d. |
| Timber, undressed, cut to sizes for making boxes | 5s. 0d. |
| Timber, for making boxes, being cut into shape, and dressed or partly dressed | 6s. 0d. |
| Timber, dressed, n. e. i. | 4s. 0d. |
| Veneer, 3 ply | 7s. 6d. |
| Veneers, n. e. i. | 5s. 0d. |
| Timber, undressed in sizes less than 7 feet 6 inches, by $2\frac{1}{2}$ x10 inches, for door stock | 3s. 0d. |
| Timber, for making doors, being cut into shape, and dressed or partly dressed | 6s. 0d. |

| | Each |
|--|---------|
| Doors of wood, including fly doors: | |
| Sizes $1\frac{1}{2}$ inches and under | 4s. 6d. |
| Sizes over $1\frac{1}{2}$ inches and under $1\frac{3}{4}$ inches | 6s. 0d. |
| Sizes $1\frac{3}{4}$ inches and over | 8s. 6d. |

| | Ad valorem |
|---|------------|
| Logs, not sawn | 5% |
| Spars, in the rough | 5% |
| Timber, bent or cut into shape, dressed or partly dressed, n. e. i. | 30% |
| Picture and room mouldings | 35% |
| Broom stocks, being square timber rough-sawn into sizes suitable for the manufacture of broom handles | 20% |
| Laths, for blinds | 30% |

DUTIES ON LUMBER—Continued

AUSTRALIA—Continued

| | Per 1000 Pcs. |
|--|-----------------------|
| Laths, n. e. i. | 10s. 0d. |
| Palings | 15s. 0d. |
| Shingles | 5s. 0d. |
| | Per 100 Pcs. |
| Pickets, undressed | 3s. 6d. |
| Pickets, dressed | 7s. 0d. |
| Staves, undressed | 1s. 0d. |
| Staves, dressed or partly dressed, but not shaped | 4s. 0d. |
| | Per 100 Lineal Ft. |
| Architraves, moldings, n. e. i., and skirtings of any material | 6s. 0d. |

In the foregoing table the import duties are the same for the General Tariff, and Preferential Tariff on lumber the produce or manufacture of the United Kingdom, with the exception that on "Picture and room moldings," the Preferential Tariff is 30% **Ad Valorem**.

"N. e. i." means "not elsewhere included."

BERMUDA

| | |
|---|------|
| Box material for export use, Barrels, Cooperage Stock | Free |
| All other wood and timber Ad Valorem | 10% |

BRITISH INDIA

| | Ad Val. |
|--|---------|
| Railway sleepers (ties) | 2½% |
| Firewood; racks for the withering of tea-leaf; also tea-chests, made up or not | 2½% |
| All other wood and timber | 7½% |

BRITISH SOUTH AFRICA

Wood, unmanufactured; ceiling and flooring boards, planed, tongued, and grooved; materials for use in construction of telegraph and telephone lines; posts, gates, hurdles, and other materials ordinarily used for agricultural or railway fencing; railway or tramway sleepers; permanent or fixed railway signals; staves, not further worked than roughly fashioned.

| Under British Preferential Tariff | Free |
|---|----------|
| | Ad. Val. |
| Under General Tariff | 3% |
| All other wood and timber: | |
| Under British Preferential Tariff | 12% |
| Under General Tariff | 15% |

CEYLON

| Timber, not prepared; shooks and staves; empty casks; sandal and dye-woods; and other woods, unwrought | Free |
|---|----------|
| Wood, imported in shooks or in any form, in which it may be used in making tea boxes, or boxes used for the despatch of samples of tea or other Ceylon products | Free |
| | Ad. Val. |
| All other wood and timber | 5½% |

DUTIES ON LUMBER—Continued

CHINA

| | Haikwan Taels |
|--|--------------------------|
| Timber, beams, hard wood | per cubic foot 0.020 |
| Soft wood, including Douglas fir and California redwood, on a thickness of 1 in. | per 1,000 sup. ft. 1.150 |
| Laths | per thousand 0.210 |
| Masts and Spars, hard wood | Ad Val. 5% |
| Masts and Spars, soft wood | Ad Val. 5% |
| Piles and Piling, including Douglas fir and California redwood, on a thickness of 1 in. | per 1,000 sup. ft. 1.150 |
| Planks, hard wood | per cubic foot 0.020 |
| Planks and Flooring, soft wood, including Douglas fir and California redwood, and allowing 10 per cent. of each shipment to be tongued and grooved, on a thickness of 1 in. | per 1,000 ft. 1.150 |
| Planks and Flooring, soft wood, tongued and grooved, in excess of above 10 per cent. | Ad Val. 5% |
| Railway sleepers | Ad Val. 5% |
| Wood not otherwise specified | 5% |

Note:—The Haikwan (Customs) Tael is not a coin but a weight in silver; the exchange value fluctuates from 63 to 66 cents.

FIJI ISLANDS

General Tariff on Timber, August, 1916.

Class of Timber—

| | Ad. Val. |
|---|----------|
| Timber cut for cases, not exceeding 3 feet in length | 12½% |
| Doors and sash | 12½% |
| Timber dressed or undressed, not over two inches wide | 12½% |

FRANCE

Rates of Duty in Dollars
Per 100 Pounds
General Minimum
Tariff Tariff

| | | |
|---|------|-------|
| Logs, rough, not squared, with or without the bark, of any length, and of a circumference at the thick end of more than 60 cm. (23.622 inches) | .088 | *.057 |
| Wood, sawed or squared, 80 mm. (3.1496 inches) or more in thickness | .13 | *.083 |
| Wood, sawed or squared, exceeding 35 mm. (1.37795 inches) but less than 80 mm. (3.1496 inches) in thickness | .15 | *.11 |
| Wood, sawed, 35 mm. (1.37795 inches) or less in thickness | .22 | *.15 |
| Surfaced wood, planed, grooved and (or) tongued planks, strips and veneers for parquetry, planed grooved and (or) tongued: Of oak or other hard wood | .66 | .44 |
| Of fir or other soft wood | .46 | .31 |
| Stave-wood—Means split wood which is intended exclusively for coo- perage or packing purposes. The customs treatment of stave wood is also applicable to sawed staves manifestly in- tended for the manufacture of casks | .11 | *.066 |
| Spilnts:—strips and laths, cut, sawed or split of a thickness not exceeding 1 cm. (0.3937 inches) | .18 | .13 |
| Cedar, sawed, 20 cm. (7.874 inches) or less in thickness | Free | Free |
| Doors, windows, venetian blinds, shutters, roll shutters, roller blinds, wood paneling, and joiners work put together or not: Of hard wood, including articles partly of hard and partly of soft wood | 2.63 | 1.75 |
| Of soft wood | 1.66 | 1.09 |
| Painted, varnished, or lacquered in a uniform color | 3.93 | 2.63 |
| Carved or with raised or sunken ornaments, gilded, or with designs in imitation of the grain of the wood, or other * Applies to imports originating in the United States or Porto Rico. | 6.57 | 4.38 |

If not otherwise indicated imports originating in the United States and Porto Rico are dutiable under the general tariff.

DUTIES ON LUMBER—Continued

JAMAICA

| | |
|--|-------------|
| All materials for use exclusively in the construction and equipment of railways and tramways | Free |
| Wood for hoops and truss-hoops; staves and headings; shooks for tierces, puncheons, barrels, hogsheds, and casks; shooks for boxes or crates to be used in packing native agricultural produce | Free |
| Pitch pine, white pine, and other lumber: | |
| Rough or sawn, per 1,000 sup. ft. (1 in. thick) | 9s |
| Planed, smoothed, grooved and tongued, ceiling and flooring boards; clinker or beaded boards, not otherwise manufactured, per 1,000 sup. ft. (1 in. thick) | 14s |
| Shingles, cypress, more than 12 in. in length, per 1,000 | 6s |
| Shingles, wallaba, per 1,000 | 6s |
| Shingles, other | Ad. Val. 4s |

JAPAN

| | |
|---|--------------------------|
| Wood, cut, sawn or split, simply: Pine, Douglas Fir, or Cedar:— | |
| Cedar not exceeding 20 cm. in length, 7 cm. in width and 17 mm. in thickness | Free |
| Not exceeding 65 mm. in thickness | per cubic metre 3.10 yen |
| Other | per cubic metre 1.80 yen |
| Wood pipe and tubes | Ad Val. 25% |
| Pulp for Paper making:— | |
| Mechanical Pulp | per 100 kin 0.22 yen |
| Other | per 100 kin 0.27 yen |
| The Japanese Yen equals 100 sen and is the equivalent to \$0.498 U. S. money. | |
| The Kin equals 1.32277 pounds. | |

NEW ZEALAND

| | Gen. Tariff | Tariff on Goods from any parts of Brit. Doms. |
|---|-------------|---|
| Timber, palings, split, per 100 | 2s | 2s |
| Posts, split, per 100 | 8s | 8s |
| Rails, split, per 100 | 4s | 4s |
| Sawn, dressed, per 100 super ft. | 4s | 4s |
| Sawn, rough, per 100 super ft. | 2s | 2s |
| Shingles and laths, per 1,000 | 2s | 2s |
| Doors and sashes, either plain or glazed, with ornamental glass | | |
| Ad. Val. | 30% | 20% |
| Woodenware and turnery, n. o. e. and veneers, | Ad Val. 30% | 20% |

PERU

| | |
|---|------|
| Sleepers of common wood | Free |
| Masts of all kinds, unwrought | Free |
| Sawn in boards, joists, beams, girders and other unenumerated shapes, per 0.023 m. in thickness:— | |
| Pine, laurel, larch, and similar | Free |
| The same, planed, tongued or grooved, or wrought in any manner, per cubic meter | 14c |

TRINIDAD AND TOBAGO

| | |
|---|-------------|
| Articles imported specially for the furnishing, decoration, construction, and repair of churches used for public worship, on the signed declaration of the head of the denomination for which they are intended | Free |
| Timber, unmanufactured: | |
| Sawn or hewn, undressed, per 1,000 ft. | 8s 4d |
| Sawn or hewn, wholly or partly dressed, per 1,000 ft. | 12s 6d |
| Shingles, per 1,000 | 1s 6d |
| All other wood and timber | Ad Val. 10% |

UNITED STATES

| | |
|--|-------------|
| Paving posts, railroad ties, and telephone, trolley, electric light, and telegraph poles of cedar or other woods | Ad Val. 10% |
| Casks, barrels, and hogsheds (empty) sugar-box shooks and packing boxes (empty) and packing-box shooks, of wood, n. s. p. | Ad Val. 15% |
| Veneers of wood | Ad Val. 15% |
| Wood: Logs, timber, round unmanufactured, hewn or sawed, sided or squared; pulp woods, kindling wood, firewood, hop poles, hoop poles, fence posts, handle bolts, shingle bolts, gun blocks for gunstocks, rough hewn or sawed, or planed on one side; hubs for wheels, posts, heading bolts, stave bolts, last blocks, wagon blocks, oar blocks, heading blocks, and all like blocks, or sticks, rough hewn, sawed or bored; sawed boards, planks, deals, and other lumber, not further manufactured than sawed, planed, and tongued and grooved; clapboards, laths, pickets, palings, staves, shingles, ship timber, ship planking, broom handles, sawdust, and wood flour; all the foregoing n. s. p. | Free |
| N. B.—Beaded ceiling and mouldings have been held to be free of duty. | |

NAUTICAL MEASURES

12 inches equals 1 foot
 3 feet equals 1 yard
 6 feet equals 1 fathom
 3 nautical miles equals 1 league

Sea or Nautical Mile—one-sixtieth of a degree of latitude, and varies from 6,046 ft. on the Equator to 6,092 ft. in lat. 60°.

Nautical Mile for speed trials, generally called the Admiralty Measured Mile—6,080 feet; 1.151 statute miles; 1,853 meters.

Cable's length—the tenth of a nautical mile; or approximately, 100 fathoms or 200 yards.

A Knot—a nautical mile an hour, is a measure of speed, but is not infrequently, though erroneously, used as synonymous with a nautical mile.

Length of European Measures of Distances compared with the Nautical Mile of 6,080 feet:

| | Length in Nautical Miles | | Length in Nautical Miles |
|-------------------------------|--------------------------------|----------------------|--------------------------------|
| Nautical Mile | 1.000 | German Ruthen | 4.064 |
| British Statute Land Mile ... | 0.868 | Italian Mile | 1.000 |
| Austrian Mile | 4.094 | Norwegian Mile | 6.097 |
| Danish Mile | 4.064 | Russian Verst | 0.576 |
| French Kilometer | 0.539 | Swedish Mile | 5.769 |
| German Geographical Mile ... | 4.030 | | |

WATER MEASURE

Weight of Fresh Water

| | |
|-------|-------------------------------------|
| 1 | cubic inch .03617 pound. |
| 12 | cubic inches .434 pound. |
| 1 | cubic foot 62.5 pounds. |
| 1 | cubic foot 7.48652 U. S. gallons. |
| 1.8 | cubic feet 112.0 pounds. |
| 35.84 | cubic feet 2240.0 pounds. |
| 1 | cylindrical inch .02842 pound. |
| 12 | cylindrical inches .341 pound. |
| 1 | cylindrical foot 49.10 pounds. |
| 1 | cylindrical foot 6.0 U. S. gallons. |
| 2.282 | cylindrical feet 112.0 pounds. |
| 45.64 | cylindrical feet 2240.0 pounds. |
| 1 | imperial gallon 10.0 pounds. |
| 11.2 | imperial gallons 112.0 pounds. |
| 224 | imperial gallons 2240.0 pounds. |
| 1 | U. S. gallon 8.355 pounds. |
| 13.44 | U. S. gallons 112.0 pounds. |
| 268.8 | U. S. gallons 2240.0 pounds. |

NOTE—The centre of pressure of water against the side of the containing vessel or reservoir is at two-thirds the depth from the surface.

WEIGHT OF SALT WATER

At 62° Fahrenheit

| | |
|---|--|
| 1 | cubic inch 259 grs. |
| 1 | cubic foot 64.11 pounds. |
| 1 | imperial gallon 10.27 pounds. |
| 1 | U. S. gallon 8.558 pounds. |
| 1 | long ton (2240 pounds) 35 cubic feet. |
| 1 | long ton (2240 pounds) 218.11 imperial gallons. |
| 1 | long ton (2240 pounds) 240 U. S. gallons. |
| 1 | short ton (2000 pounds) 31.2 cubic feet. |
| 1 | short ton (2000 pounds) 194.74 imperial gallons. |
| 1 | short ton (2000 pounds) 233.7 U. S. gallons. |

DENSITY OF WATER AND COAL CONSUMPTION

When figuring on a vessel's draft allowance must be made for density of water; that is, the difference in weight between fresh and salt water, also consumption of coal on inland waters. The usual method employed is to add to draft at load line one or two inches according to circumstances.

IMMERSION IN SALT AND FRESH WATER

To find the difference of immersion or draft in salt and fresh water: If from salt to fresh, multiply the draft of salt water by 36, and divide the product by 35. If from fresh to salt, multiply the draft of fresh water by 35 and divide the product by 36.

Example:

Required the draft of a vessel in fresh water when drawing 20 ft. in salt water:
 $20 \text{ ft.} \times 36 = 720 \div 35 = 20 \text{ ft. } 7 \text{ in.}$

BARRELS

To find the number of gallons in a cask or barrel.

Rule:

Take all the dimensions in inches. Add the head and bung diameters and divide by 2 for the approximate mean diameter. Square the mean diameter and multiply by the depth. Multiply the result by .0034 for gallons.

Example:

How many gallons are contained in a cask the bung diameter of which is 24 inches, the head diameter, 22 inches, and the depth 30 inches?

Operation:

$22 + 24 = 46 \div 2 = 23$ (mean diameter). Square of $23 = 529 \times 30$ (depth) $= 15870$. $15870 \times .0034 = 53.9$ gallons.

MEASURING TANKS

To find the number of gallons contained in a tank.

Rule:

Multiply the cubic capacity in feet by 7.48.

Example:

How many gallons in a tank 6x6x4 feet?

Explanation:

$6 \times 3 \times 4 = 72$ cubic feet. $7.48 \times 72 = 538.56$ gallons. $538.56 \div 31\frac{1}{2} = 17.10$ — bbl.

CISTERNS

To find the capacity of a cistern.

Rule:

Multiply the square of the diameter by the depth; this will give the cylindrical feet; multiply the cylindrical feet by $5\frac{1}{8}$ for gallons; .1865 for barrels, or .09325 for hogsheads.

Example:

How many gallons in a cistern 42 feet in diameter, 12 feet deep?

Operation:

$42 \times 42 = 1764$; $1764 \times 12 = 21168$; $5\frac{1}{8} \times 21168 = 124362$ gallons.—Answer.
How many barrels?—Answer, 394.8.

EXPLANATION OF TONNAGE AND DISPLACEMENT

Many different tonnage units are employed in the overseas export trade. Tonnage is of two general kinds: cargo tonnage, which expresses the quantity of cargo being shipped, and vessel tonnage, which expresses the size or capacity of the ship.

CARGO TONNAGE

Cargo tonnage may be stated in four ways: (1) Long tons of 2,240 pounds each, (2) metric tons of 2,204 pounds, (3) short tons of 2,000 pounds, or (4) measurement tons—usually of 40 cubic feet. Long tons and measurement tons are most commonly used in the overseas export trade of the United States, the former usually in connection with cargoes shipped in terms of their weight, and the latter in connection with light freight or general cargoes which are frequently shipped on the basis of the space which they occupy.

VESSEL TONNAGE

Vessel tonnage is expressed in four ways: (1) Displacement tonnage, (2) dead-weight tonnage, (3) gross tonnage, (4) net tonnage. Displacement tonnage indicates the weight of the vessel or of the water displaced by it and in the United States is expressed in terms of the avoirdupois ton of 2,240 pounds. It may be either "light displacement," which represents the vessel's weight when its crew and supplies are on board, but before any fuel, cargo or passengers have been loaded; or, it may be "maximum" or "full load displacement," which represents the vessel's weight when fully loaded to its deep load line.

DEADWEIGHT TONNAGE

A vessel's deadweight tonnage represents the maximum weight of cargo and fuel which it is able to carry when loaded to its deep load line. It is the difference between its light and maximum displacement tonnage, and is, in case of the United States, usually expressed in terms of the long ton.

GROSS TONNAGE

The gross register tonnage of a vessel is its total inclosed content expressed in tons of 100 cubic feet, as ascertained by the measurement authorities of the vessel's home country.

NET TONNAGE

A vessel's net tonnage, theoretically, should represent the cubical contents of the space available for cargoes and passengers expressed in tons of 100 cubic feet. In practice, however, it understates the real net capacity of a vessel and varies according to the particular national measurement rules which are applied. Net tonnage is ascertained by making certain deductions from the vessel's gross tonnage as prescribed by the measurement rules of various countries.

DOUGLAS FIR SHIPMENTS**POINTERS FOR SHIPOWNERS ON LUMBER CARRYING CAPACITY OF STEAMERS**

When figuring on the lumber carrying capacity of steamers, allowance must be made for bunker coal, stores, provisions, boiler and feed water, water ballast, type of vessel, and height of deckload she will safely carry, also proportion of sizes and lengths in the lumber specifications suitable for stowage on deck and in the various compartments under deck, the number of timbers to be carried, and whether short lumber, pickets and or lath will be supplied for broken stowage.

In a large number of instances specifications contain every requisite for making good stowage, but it is of no avail if the lengths and sizes are not piled on the dock prior to shipment so as to be available at the right time and place to fill the various compartments.

If the lumber for shipment is not placed on the dock right, poor stowage and a great decrease in the amount of cargo the vessel should carry will be the result and the time of loading will often be increased several days.

Poor stowage under deck results in vessel becoming top heavy, and consequently the usual height of deckload cannot be carried, as extra ballast tanks have to be filled to stiffen vessel and keep her upright.

This seriously affects the cargo carrying capacity of a vessel; for instance, filling a ballast tank of 300 tons would decrease the amount of cargo carried by 200,000 board feet of lumber.

When a steamer lists before she has a reasonable deckload, the cause should be investigated. There are instances where the fuel for main or donkey boilers is taken from one side of the upper portion of bunkers, emptying or filling a boiler, feeding water in boilers from one side of an engine tank with a central division, filling or emptying ballast tanks, or slack water in ballast tanks; the latter being the principal cause.

TO COMPUTE LUMBER CARRYING CAPACITY UNDER DECK

To compute lumber carrying capacity of a steamer, ascertain from the builder's plan the cubical capacity (bale space) of the various compartments, add together and multiply the total by $8\frac{1}{2}$; the result will be the capacity in board feet.

Example:

How much lumber in board feet will a steamer carry under deck with a total cargo carrying capacity of 300,000 cubic feet (bale space)?

Operation:

$$300,000 \times 8\frac{1}{2} = 2,500,000, \text{ the amount in board feet.}$$

Note:

To multiply by $8\frac{1}{2}$ add two ciphers and divide by 12.

TO COMPUTE DEADWEIGHT LUMBER CARRYING CAPACITY OF A STEAMER

To ascertain the deadweight lumber carrying capacity of a steamer, the following particulars should be obtained:

Distance between sailing and discharging port.

Speed of vessel, and daily coal consumption.

Weight of ship's stores and provisions.

Estimate of water ballast required.

Bunker coal necessary for voyage.

The first thing to do is to find out from the builder's plan, owners or officers of vessel, the speed in knots per hour and daily coal consumption; then compute the bunker coal required for the voyage as follows:

Example:

How much bunker coal will a steamer consume on a voyage from Seattle, Wash., U. S. A., to Sydney, N. S. W., Australia, the distance being 6829 nautical miles, speed 8 knots (nautical miles) per hour, and the daily consumption 29 tons of coal?

Multiply the knots (8) by 24; this gives the distance traveled per day. Then divide the result (192) into the distance between loading and discharging port. In this case it is 6829 nautical miles; the answer will be the number of days occupied on voyage. Now multiply the number of days by the coal consumption (29) and you will have the bunker coal required for the voyage.

Operation:

$8 \times 24 = 192$, the daily speed. $6829 \div 192 = 35.57$, the number of days on voyage. $35.57 \times 29 = 1031.53$, the amount of bunker coal in tons required for the voyage.

Note:

It is customary to allow a few days reserve coal so that if steamer meets with an accident or bad weather the extra coal should enable her to reach port in safety. In this case an allowance of three days reserve coal should suffice.

METHOD OF ESTIMATING DEADWEIGHT TOTALS BEFORE OR AFTER LOADING

Capacity of vessel 7200 tons deadweight.

| | Tons |
|---|-------|
| Bunker coal | 1931 |
| Bunker coal, reserve | 87 |
| Water ballast | 400 |
| Engine tank, fresh water | 182 |
| Stores and provisions | 75 |
| Fresh drinking water | 25 |
| | <hr/> |
| | 1800 |
| 3,600,000 ft. @ $1\frac{1}{2}$ tons per 1000 ft. | 5400 |

7200

The ordinary tramp steamer with coal for bunker fuel will not stand up with a high deckload without water ballast, therefore in the foregoing estimate a fair allowance has been made.

TO COMPUTE LUMBER CARRYING CAPACITY OF A STEAMER ON DECK

This is practically impossible, as so much depends on the stowage of cargo under deck, and also the height at which the bunker coal is stowed, whether it is winter or summer loading, the type and beam of vessel and amount of water ballast required.

When estimating on the amount of deckload always take the possible height into consideration, and remember that a steamer cannot carry more than her deadweight according to displacement scale.

The trick in loading steamers with lumber is to load them with the minimum of water ballast, and that can only be done by having an expert supervise the assembling or piling of the cargo beforehand, and taking advantage of every point during loading. This will greatly assist the stevedore, the mill company and ship's officers, and be of immense benefit to all concerned.

NEWSPRINT PAPER

CARGO SHIPMENTS OF PAPER IN CONJUNCTION WITH DOUGLAS FIR AND REDWOOD

As the shipment of print paper in rolls from British Columbia and the Pacific ports of the United States to Australia, New Zealand and other countries will supplant this trade which formerly was held by Germany, the following information will be of considerable assistance to those interested in this particular line.

The ordinary tramp steamer of about 7000 tons deadweight can carry a full cargo of paper under deck, with Redwood doorstock and/or dry lath or pickets for stowage, also a deckload of lumber equal in capacity and height to the amount that the steamer would ordinarily carry with a straight cargo of Douglas Fir, provided that good stowage is made both under and on deck.

DIMENSIONS OF PAPER ROLLS

Paper rolls vary according to orders of foreign buyers, though they usually run from 21 $\frac{1}{4}$ inches to 84 inches in height, with a preponderance of 39-inch rolls. The diameter of rolls vary, but 34 to 36 inches could be considered a fair average. The height of roll is the net size (the width of paper) and an allowance of three inches extra in height should be made for wrapping paper.

In some cases the ends of rolls are wooded, which means that the top and/or bottom ends are protected by boards about three-quarters of an inch in thickness and shaped to conform to the circular area of the end of the roll. The length and gross weight in pounds is stencilled on the side of each roll.

Rolls about 21 inches in height are called cheese rolls at point of shipment. This is on account of their resembling a roll of cheese.

These rolls are a very valuable aid to stowage. They can be used on their bilge or flat side to great advantage in the wings, between the top course of paper and beams, or any place where a larger roll would not go.

The following is an original specification of a shipment of paper rolls for Sydney, Australia, which gives a very fair idea of the dimensions and weight of the average paper roll:

SPECIFICATIONS GIVING DIMENSIONS AND WEIGHT OF NEWSPAPER ROLLS FOR FOREIGN SHIPMENT

| Number of Rolls | Height Inches | Diam. Inches | Average Weight in Pounds | Gross Weight in Pounds | Tare Weight in Pounds | Net Weight in Pounds |
|-----------------|------------------|--------------|--------------------------|------------------------|-----------------------|----------------------|
| 641 | 39 | 34 | 710 | 454,972 | 13,621 | 441,351 |
| 180 | 35 | 34 | 650 | 117,107 | 3,600 | 113,507 |
| 600 | 39 | 34 | 650 | 390,348 | 12,750 | 377,598 |
| 1,844 | 84 | 36 | 1,700 | 3,126,236 | 95,888 | 3,030,348 |
| 1,827 | 42 | 36 | 836 | 1,526,682 | 39,280 | 1,487,402 |
| 1,023 | 21 $\frac{1}{4}$ | 36 | 435 | 445,386 | 14,322 | 431,064 |
| 6,115 | | | | 6,060,731 | 179,461 | 5,881,270 |

HOW TO DUNNAGE AND STOW PAPER ROLLS IN A SHIP'S HOLD

Stanchions, pillars, frames or any section of compartment composed of steel or iron should be covered with burlap or otherwise dunnaged so as to prevent paper from being damaged through coming in contact with or chafing against the steel or iron parts mentioned.

Before loading, the floors of the various holds should be dunnaged with lumber to prevent damage and levelled to make a solid foundation for the paper rolls. The after holds and especially the aftermost hold where the rise of the floor is very acute, should be filled with cargo other than paper if available to about the top of the shaft tunnel.

Paper rolls must be stowed on end on a practically level floor; if stowed on bilge (side) they would be crushed out of shape by the upper courses and rendered useless for the purpose for which they are intended as they would not then revolve evenly on the newspaper machine cylinder.

Cargo hooks must not be used to handle paper rolls, and extreme care must be used to guard against the rolls striking against side of vessel, hatch coamings or other obstructions during process of loading.

If order of loading permits, the longest rolls should be stowed first in the hold; then the next to the longest length in rotation, reserving the shorter rolls to be used where a long roll cannot be stowed.

NEWSPRINT PAPER—Continued

SHORT STOWAGE REQUIRED

Short stowage which must be dry is required to fill spaces between paper rolls; also in wings (sides), against iron bulkheads and in vacant spaces between the top course of rolls and beams of vessel.

One hundred thousand board feet of dry doorstock, box shooks, dry lath or dry pickets is required to stow one thousand gross long tons of paper.

If lumber or stowage is loaded on steamer prior to taking paper cargo, it should be stowed in one end of each compartment only, preferably the narrow end.

If spread over the entire floor space it would have to be rehandled and thus delay the work of loading. When stowed in one end of a compartment, work of loading can commence in the vacant end immediately vessel arrives at paper mill, and the stowage in the other end can be used when required without retarding the work.

It is a cardinal rule never to use a short roll except for an emergency, as they are easily handled and if they are not all utilized during loading they will come in very handy to finish off with.

CUBIC STOWAGE PER TON OF PAPER ROLLS

Under favorable conditions such as a vessel with large compartments or when the orders contain a large quantity of medium sized rolls or of a length that will stow from floor to beams without loss of space, about ninety-one cubic feet bale space should be allowed for one gross long ton of paper.

When there is a great variety of sizes, or the lengths are such that good stowage cannot be made owing to build of vessel or for any reason that results in a loss of space between the upper course and beams an allowance of at least ninety-five cubic feet bale space should be made.

BUNKER SPACE

All available space under deck should be reserved for cargo, and only enough bunker capacity allowed to cover the run on the longest leg of the voyage. For instance, a steamer from British Columbia or the U. S. North Pacific Coast, with a cargo destined for Sydney, Australia, should not take coal for the entire voyage, but should replenish her bunkers at Honolulu, Hawaii, taking sufficient coal there to safely carry her to Sydney.

By referring to the following distances the benefit of replenishing bunkers at Honolulu will be apparent:

Distance from Victoria, B. C., to Honolulu, 2349 nautical miles.

Distance from Port Townsend, Wash., to Honolulu, 2366 nautical miles.

Distance from Honolulu to Sydney, Australia, 4420 nautical miles.

A vessel making nine knots per hour on a daily consumption of 28 tons of coal would be 20½ days on the voyage from Honolulu to Sydney, and would require a minimum of 574 tons of coal. To this amount should be added about four days' extra supply of coal or 112 tons as a reserve against accident or bad weather.

STABILITY

Contrary to a general supposition a steamer with a full cargo of paper under deck, and broken spaces well filled with short stowage, and a full and complete deckload of about 800,000 board feet of Douglas Fir and averaging about eleven feet in height, will stand up as well at the finish as if the entire cargo was Douglas Fir.

The reason for this is, that with a paper cargo under deck all bottom ballast tanks would be full, and with a straight cargo of Douglas Fir about half of the bottom ballast tanks of a capacity of say 600 tons would be empty. Therefore the extra weight of ballast required for a paper cargo would be in the bottom of the vessel and offset the heavier weight of Douglas Fir at a higher elevation in the hold.

DEADWEIGHT

The ordinary tramp steamer loaded under foregoing conditions would probably be six to ten inches off her summer marks with all bottom ballast tanks full.

Therefore if it is possible to obtain as cargo about 500 tons deadweight of iron, lead, steel, tin, canned salmon or any commodity of a specific gravity several times heavier than water that can safely be stowed in bottom of vessel it would be an aid to stability and add to freight profits by replacing a large portion of water ballast with profitable cargo.

POINTERS ON FILLING BALLAST TANKS

In loading steamer with a combination of paper and lumber it is good policy to regulate the weight of cargo and stowage in such a manner that the vessel can be loaded to her marks with one or more small double bottom ballast tanks empty, so that in event of vessel becoming tender towards the end of the voyage, through burning the coal stowed in the lower part of bunkers, the bottom tanks could be filled and the steamer would retain her stability by substituting the water ballast for coal.

If possible leave tanks of small capacity empty, as they are only filled during voyage in case of emergency, it being considered a hazardous undertaking for a steamer with a high deckload to fill a large tank at sea, as the rolling of vessel would cause the slack water to rush to one side of the tank which would probably result in the steamer taking a very dangerous list.

CONVERSION OF U. S. AND ENGLISH MONEY

According to Act of Congress, March 8, 1873, the Pound Sterling of Great Britain equals \$4.8665; the value of one shilling equals \$0.24 $\frac{1}{4}$; the value of one penny equals \$0.02.

Table of Sterling Money

- 4 Farthings (far) equal 1 penny (d.).
 12 Pence equal 1 shilling (s.).
 20 Shillings equal 1 pound (£).

A Simple Process to Change Pounds, Shillings and Pence to Dollars and Cents

Reduce pounds to shillings, add in the shillings, if any, and multiply the sum by .24 $\frac{1}{4}$; if any pence are given, increase the product by TWICE as many cents.

Reduce £185, 17s. and 9d. to U. S. money:

$$\begin{array}{r}
 185 \times 20 = 3700 \\
 \quad \quad 17 \\
 \hline
 \text{Shillings, } 3717 \\
 3717 \times .24\frac{1}{4} = 904.47 \\
 + 9\text{d.} = .18 \\
 \hline
 \text{Ans. } \$904.65
 \end{array}$$

Another Simple Method to Reduce Pounds to Dollars, and Vice Versa Exchange Being at \$4.8665

Multiply the number of pounds by 73, and divide the product by 15; the result will express its equivalent in dollars and cents. Or,

Multiply dollars by 15 and dividing the product by 73, will give its equivalent in Pounds and decimals of a Pound.

How many dollars in £96?

$$£96 \times \frac{73}{15} = \$467.20. \text{ Ans.}$$

How many pounds in \$839.50?

$$\$839.50 \times \frac{15}{73} = £172.5. \text{ Ans.}$$

TO COMPUTE LUMBER SHIPMENTS IN POUNDS, SHILLINGS AND PENCE

In making up Bills of Lading for British countries, the rate per thousand is invariably figured in English money. The following method explains the usual way of computing the freight in pounds, shillings and pence.

Example No. 1:

What will the total freight amount to in sterling money on a shipment of lumber containing 220,024 board feet at £3 10s. 0d. per thousand.

Operation:

$$\begin{array}{r}
 220,024 \times £3\frac{1}{2} \text{ (£3 10s.) equals } £770.084 \\
 \quad \quad \quad 20 \\
 \hline
 \text{Shillings } 1.680 \\
 \quad \quad \quad 12 \\
 \hline
 \text{Pence } 8.160
 \end{array}$$

Answer: £770 1s. 8d.

Explanation:

As the rate of freight is per thousand feet, point off three figures and multiply by £3 $\frac{1}{2}$, which is the equivalent of £3 10s. 0d. This gives £770 and decimal .084 of a pound. Multiply .084 by 20 to obtain the shillings and .680 by 12 to obtain the pence.

TO COMPUTE LUMBER SHIPMENTS—Continued

Example No. 2:

What will the total freight amount to in sterling money on a shipment of lumber containing 86,976 board feet at £2 6s. 9d. per thousand?

In this instance it is advisable to bring the pounds and shillings to pence, which in this case amounts to 561 pence.

Operation:

| | |
|--------|------------|
| 86.976 | Board Feet |
| 561 | Pence |

| |
|--------|
| 86976 |
| 521856 |
| 434880 |

12)48793.536

20)4066.128 (Multiply .128 by 12 to obtain the pence which is 1.536 or $1\frac{1}{2}$ d.)

203.6

Answer: £203 6s. $1\frac{1}{2}$ d.

Explanation:

As the rate of freight is per thousand, point off three figures and multiply by 561 (the pence). Divide the product by 12 which gives 4066 shillings and decimal point 128 of a shilling. Now divide 4066 shillings by 20, to obtain the pounds. This gives 203 pounds and six shillings. To obtain the pence multiply .128 by 12; this gives 1.536 or $1\frac{1}{2}$ pence.

TO MAKE A WATCH ANSWER FOR A COMPASS

If the watch is on time, turn it around so that the hour hand will point to the sun. Then just mid-way between where the hour hand points on the dial and 12 o'clock on the dial, is SOUTH.

It is of no consequence what time of day, or what time of year it is—the rule applies at all times any place north of the equator.

Absolute exactness is not claimed for this rule, but it is always near enough for practical purposes.

Note—Pay no attention to the minute hand.

LONGITUDE AND TIME

Since the earth revolves around its axis in 24 hours, and its circumference is divided into 360 degrees, the sun apparently passes over 15 degrees in 1 hour ($360 \div 24 = 15$); and consequently over 1 degree in 4 minutes ($60 \div 15 = 4$). Hence, these simple Rules:

Rule—Multiplying the Longitude, expressed in degrees, by 4 gives the equivalent Time expressed in minutes.

Rule—Dividing the Time, expressed in minutes, by 4 gives the equivalent Longitude expressed in degrees.

The difference in Longitude between Boston and San Francisco is nearly $51\frac{1}{4}$ degrees; what is the difference in Time?

Answer— $51\frac{1}{4} \times 4 = 205$ min., or 3 h. 25 min.

The difference in Time between London and New York is nearly 4 h. and $51\frac{1}{4}$ min.; what is the difference in Longitude?

Answer—4 h. $55\frac{1}{2}$ min. = $295\frac{1}{2}$ min. $295\frac{1}{2} \div 4 = 73\frac{3}{8}$ deg.

Notes—A degree of Longitude at the equator is 69.16 miles; at ten degrees of Latitude, 68 miles; at twenty degrees, 65 miles; at thirty degrees, 60 miles; at forty degrees, 53 miles; at fifty degrees, 44.5 miles; at sixty degrees, 34.6 miles, etc. Thus longitude gradually diminishes with each degree of latitude, till at the poles it runs to nothing, as all the meridians converge from the equator to a point at the poles.

The degrees of Latitude run parallel, and would be equally distant apart were the earth a perfect sphere, but owing to its polar diameter being $26\frac{1}{2}$ miles shorter than its equatorial diameter, the first degree being 68.8 miles; the forty-fifth, 69 miles, and the ninetieth, 69.4 miles.

The earth's equatorial diameter is 7925.6 miles. Its polar diameter, 7899.1 miles.

BENEFIT OF TABLE OF DISTANCES AND DIFFERENCE IN TIME TABLE

The table of distances and difference in time table included in this work will prove a valuable aid to shipowners and lumbermen engaged in the export cargo trade, as it will enable them to quickly arrive at the distance between loading and discharging ports, and the time that vessel would be due to arrive at destination.

Steamers on long voyages do not always go direct to destination, but invariably stop at one or more coaling ports for bunkers.

The distances in this book are arranged with this object in view, thereby enabling the reader to ascertain the distance from the principal ports of the world to any Douglas Fir or Redwood cargo mill on the Pacific Coast.

Vessels destined for British Columbia ports usually stop first at Victoria, Vancouver Island; for Puget Sound ports at Port Townsend, Wash.; for Portland and Columbia River ports at Astoria, Ore. This stop is made for any of the following reasons: To call for orders, pass quarantine, fumigate, enter, or take a local pilot if proceeding to inland waters.

To ascertain the distance between ports it is often necessary to refer to one or more route ports. As an illustration, presume you wish to find the distance from Seattle, Wash., to Liverpool, England, you would trace the distance by following the nearest navigable route, which is as follows:

| | |
|--|---------------------|
| Seattle, Wash., to Port Townsend | 39 Nautical Miles |
| Port Townsend to Panama, C. Z. | 3985 Nautical Miles |
| Panama, C. Z., to Colon, C. Z. | 43 Nautical Miles |
| Colon, C. Z., to Liverpool, via Mona Passage | 4548 Nautical Miles |
| Total distance | 8615 Nautical Miles |

To trace the distance to the Mediterranean Sea ports, such as Barcelona, Spain; Marseilles, France; Genoa and Naples, Italy, and Alexandria and Port Said, Egypt, use the following route ports: Panama, Colon and Gibraltar.

LENGTH OF PANAMA CANAL

The distance from Panama Roads, Canal Zone, to Colon, Canal Zone, is 43 nautical, or 50 statute, miles.

TO COMPUTE TIME OCCUPIED ON VOYAGE

To compute the number of days that a full powered steamer would occupy on a voyage, the following data is necessary.

Difference in time between port of departure and port of destination. Distance between ports, and the speed of steamer in knots (nautical miles) per hour.

Example:

A steamer averaging 10 knots per hour leaves Sydney, New South Wales, Eastern Australia, at 6 a. m., January 2nd (Australian time), bound for Portland, Oregon. When is she due at destination?

Process:

By referring to the "Difference in Time Table," you will note the difference in time between Eastern Australia and the U. S. Pacific Coast is 18 hours. Therefore the first thing to do is to adjust the Australian time to correspond to that of the U. S. Pacific Coast, which in this case will be noon, January 1st. The number of nautical miles from port to port is found by reference to the Honolulu "Distance Table," which gives the distance to both Sydney and Portland, the total being 6,752 nautical miles.

The number of knots per hour (10) is multiplied by (24) the hours per day, which equals 240 knots, or nautical miles, and is divided into 6752, the number of nautical miles covered by steamer on voyage, which gives 28.133 days, or the equivalent of 23 days 3 hours.

This is added to the Pacific Coast time of steamer's departure from Sydney, making January 29th three p. m. as the time vessel is due at Portland, Oregon, without allowing for stoppages.

Note:

It is customary for a steamer destined for Portland, Oregon, to proceed to the entrance of the Columbia River, and there pick up a bar pilot, who takes the vessel to Astoria.

The services of the bar pilot are dispensed with at Astoria, where a Columbia River pilot is engaged to take the vessel to Portland.

DIFFERENCE IN TIME TABLE

When it is noon today from Vancouver, B. C., to San Diego, California:

| | | | |
|--|-------|------------|----------|
| In Washington and Boston | it is | 3:00 p.m. | today |
| In New York and Philadelphia | it is | 3:00 p.m. | today |
| In Chicago, St. Louis and New Orleans .. | it is | 2:30 p.m. | today |
| In Cheyenne and Denver | it is | 1:00 p.m. | today |
| In Sitka, Alaska | it is | 11:00 a.m. | today |
| In Porto Rico | it is | 4:00 p.m. | today |
| In Panama Canal Zone | it is | 3:00 p.m. | today |
| In Honolulu, Hawaiian Islands | it is | 9:30 a.m. | today |
| In Tutuila, Samoa | it is | 8:30 a.m. | tomorrow |
| In Guam Islands | it is | 5:30 a.m. | tomorrow |
| In Manila, Philippine Islands | it is | 4:00 a.m. | tomorrow |
| In Argentine | it is | 3:43 a.m. | tomorrow |
| In Australia, Western | it is | 4:00 a.m. | tomorrow |
| In Australia, Central | it is | 5:30 a.m. | tomorrow |
| In Australia, Eastern | it is | 6:00 a.m. | tomorrow |
| In Austria-Hungary | it is | 9:00 p.m. | today |
| In Belgium | it is | 8:00 p.m. | today |
| In Borneo (British North) and Labuan .. | it is | 4:00 a.m. | tomorrow |
| In Brazil (Rio de Janeiro) | it is | 5:00 p.m. | today |
| In Chile | it is | 3:30 p.m. | today |
| In China (Hongkong) | it is | 4:00 a.m. | tomorrow |
| In China (Saigon) | it is | 3:00 a.m. | tomorrow |
| In Colombia (Bogota) | it is | 3:00 p.m. | today |
| In Costa Rica | it is | 3:30 p.m. | today |
| In Cuba | it is | 3:30 p.m. | today |
| In Denmark | it is | 9:00 p.m. | today |
| In Ecuador | it is | 2:45 p.m. | today |
| In Egypt | it is | 10:00 p.m. | today |
| In England | it is | 8:00 p.m. | today |
| In Fiji Islands (Suva) | it is | 8:00 a.m. | tomorrow |
| In France | it is | 8:00 p.m. | today |
| In Germany | it is | 9:00 p.m. | today |
| In Gibraltar | it is | 8:00 p.m. | today |
| In Greece | it is | 9:30 p.m. | today |
| In Holland | it is | 8:00 p.m. | today |
| In Honduras | it is | 2:00 p.m. | today |
| In India (Madras) | it is | 1:30 a.m. | tomorrow |
| In Ireland | it is | 7:30 p.m. | today |
| In Italy | it is | 9:00 p.m. | today |
| In Jamaica (Kingston) | it is | 3:00 p.m. | today |
| In Japan | it is | 5:00 a.m. | tomorrow |
| In Java | it is | 3:00 a.m. | tomorrow |
| In Korea | it is | 5:00 a.m. | tomorrow |
| In Madagascar (Tananarivo) | it is | 11:00 p.m. | today |
| In Malta | it is | 9:00 p.m. | today |
| In Mauritius | it is | midnight | tonight |
| In Mexico | it is | 1:30 p.m. | today |
| In Newfoundland | it is | 4:30 p.m. | today |
| In New Zealand | it is | 7:30 a.m. | tomorrow |
| In Nicaragua | it is | 2:15 p.m. | today |
| In Nome, Dutch Harbor | it is | 9:00 a.m. | today |
| In Norway | it is | 9:00 p.m. | today |
| In Peru | it is | 3:00 p.m. | today |
| In Portugal | it is | 7:30 p.m. | today |
| In Russia (Irkutsk) | it is | 3:00 a.m. | tomorrow |
| In Russia (Pulkova) | it is | 10:00 p.m. | today |
| In Russia (Vladivostok) | it is | 5:00 a.m. | tomorrow |
| In Singapore | it is | 3:00 a.m. | tomorrow |
| In Spain | it is | 8:00 p.m. | today |
| In Sweden | it is | 9:00 p.m. | today |
| In Switzerland | it is | 9:00 p.m. | today |
| In Tunis | it is | 8:00 p.m. | today |
| In Turkey | it is | 10:00 p.m. | today |
| In Uruguay | it is | 4:15 p.m. | today |
| In Valdez, Fairbanks, Tanana | it is | 10:00 a.m. | today |
| In Venezuela | it is | 3:30 p.m. | today |

Courtesy of "North Pacific Ports"

INLAND WATERS

PUGET SOUND, WASHINGTON AND BRITISH COLUMBIA PORTS

Nautical Miles

| From undermentioned ports to | Bellingham | Cape Flattery | Comox, B. C. | Dupont | Everett | Nanaimo, B. C. | Port Angeles | Port Blakeley | Port Gamble |
|------------------------------|------------|---------------|--------------|--------|---------|----------------|--------------|---------------|-------------|
| Anacortes | 15 | 96 | 126 | 107 | 62 | 75 | 43 | 67 | 45 |
| Bellingham | ... | 111 | 130 | 122 | 77 | 60 | 58 | 82 | 59 |
| Blaine | 36 | 110 | 105 | 132 | 88 | 54 | 62 | 93 | 75 |
| Bremerton | 84 | 129 | 194 | 39 | 35 | 127 | 73 | 10 | 39 |
| Cape Flattery | 111 | ... | 190 | 155 | 117 | 141 | 56 | 121 | 102 |
| Comox, B. C. | 130 | 190 | ... | 208 | 170 | 53 | 143 | 175 | 157 |
| Dungeness | 44 | 72 | 136 | 84 | 46 | 88 | 15 | 51 | 33 |
| Departure Bay | 75 | 141 | 52 | 165 | 127 | 7 | 91 | 132 | 115 |
| Dupont | 122 | 155 | 208 | ... | 56 | 165 | 98 | 35 | 59 |
| Everett | 77 | 117 | 170 | 56 | ... | 127 | 60 | 28 | 24 |
| Esquimalt, B. C. | 50 | 59 | 132 | 102 | 64 | 90 | 19 | 69 | 50 |
| Friday Harbor | 38 | 80 | 110 | 95 | 57 | 65 | 42 | 62 | 44 |
| James Island | 52 | 78 | 114 | 105 | 67 | 70 | 36 | 72 | 54 |
| Mukilteo | 73 | 113 | 165 | 52 | 4 | 120 | 53 | 23 | 22 |
| Nanaimo, B. C. | 60 | 141 | 53 | 165 | 127 | ... | 94 | 132 | 114 |
| Neah Bay | 97 | 7 | 183 | 148 | 110 | 134 | 50 | 115 | 97 |
| Olympia | 133 | 168 | 221 | 16 | 76 | 178 | 111 | 49 | 82 |
| Port Angeles | 58 | 56 | 143 | 98 | 60 | 94 | ... | 65 | 47 |
| Point Atkinson | 64 | 133 | 74 | 159 | 121 | 28 | 88 | 126 | 108 |
| Port Blakeley | 82 | 121 | 175 | 35 | 28 | 132 | 65 | ... | 30 |
| Port Crescent | 63 | 44 | 146 | 108 | 71 | 88 | 12 | 76 | 58 |
| Port Gamble | 59 | 102 | 157 | 59 | 24 | 114 | 47 | 30 | ... |
| Port Ludlow | 53 | 98 | 153 | 56 | 22 | 110 | 43 | 26 | 6 |
| Point No Point | 59 | 103 | 156 | 50 | 14 | 113 | 46 | 19 | 11 |
| Port Townsend | 42 | 89 | 141 | 69 | 31 | 97 | 30 | 36 | 17 |
| Point Wilson | 39 | 85 | 138 | 70 | 32 | 95 | 28 | 37 | 19 |
| Powell River, B. C. | 118 | 180 | 20 | 210 | 172 | 50 | 138 | 171 | 159 |
| Seattle | 81 | 123 | 179 | 34 | 28 | 134 | 69 | 7 | 33 |
| Steilacoom | 114 | 160 | 206 | 5 | 52 | 162 | 98 | 30 | 61 |
| Tacoma | 100 | 144 | 196 | 20 | 46 | 153 | 87 | 25 | 51 |
| Union Bay, B. C. | 125 | 185 | 5 | 203 | 165 | 54 | 140 | 170 | 152 |
| Vancouver, B. C. | 70 | 140 | 27 | 165 | 128 | 35 | 94 | 132 | 114 |
| Victoria, B. C. | 43 | 59 | 129 | 100 | 62 | 84 | 18 | 67 | 50 |
| Possession Point | 62 | 108 | 159 | 53 | 8 | 116 | 49 | 19 | 16 |

INLAND WATERS

PUGET SOUND, WASHINGTON, AND BRITISH COLUMBIA PORTS

Nautical Miles

| From undermentioned ports to— | Port Ludlow | Port Townsend | Powell River, B. C. | Seattle | Tacoma | Union Bay, B. C. | Vancouver, B. C. | Victoria, B. C. |
|-------------------------------|-------------|---------------|---------------------|---------|--------|------------------|------------------|-----------------|
| Anacortes | 45 | 30 | 116 | 69 | 88 | 121 | 68 | 31 |
| Bellingham | 53 | 42 | 118 | 81 | 100 | 125 | 70 | 43 |
| Blaine | 69 | 58 | 98 | 94 | 114 | 100 | 49 | 53 |
| Bremerton | 36 | 44 | 184 | 13 | 25 | 190 | 139 | 74 |
| Cape Flattery | 98 | 89 | 180 | 123 | 144 | 185 | 140 | 59 |
| Comox, B. C. | 153 | 141 | 20 | 179 | 196 | 5 | 27 | 129 |
| Dungeness | 28 | 17 | 130 | 53 | 72 | 131 | 80 | 19 |
| Departure Bay | 109 | 98 | 48 | 135 | 150 | 45 | 34 | 82 |
| Dupont | 56 | 69 | 210 | 34 | 20 | 203 | 165 | 100 |
| Everett | 22 | 31 | 172 | 28 | 46 | 165 | 128 | 62 |
| Esquimalt, B. C. | 43 | 33 | 129 | 71 | 89 | 128 | 86 | 4 |
| Friday Harbor | 37 | 28 | 106 | 65 | 83 | 106 | 57 | 30 |
| James Island | 50 | 37 | 112 | 72 | 93 | 115 | 67 | 23 |
| Mukilteo | 18 | 24 | 167 | 25 | 43 | 160 | 120 | 55 |
| Nanaimo, B. C. | 110 | 97 | 50 | 134 | 153 | 54 | 35 | 84 |
| Neah Bay | 93 | 80 | 177 | 117 | 136 | 179 | 129 | 49 |
| Olympia | 76 | 81 | 223 | 50 | 24 | 216 | 178 | 115 |
| Port Angeles | 43 | 30 | 138 | 69 | 87 | 140 | 94 | 18 |
| Point Atkinson | 104 | 92 | 66 | 128 | 148 | 69 | 7 | 76 |
| Port Blakeley | 26 | 36 | 171 | 7 | 25 | 170 | 132 | 67 |
| Port Crescent | 54 | 41 | 143 | 78 | 97 | 148 | 106 | 19 |
| Port Gamble | 6 | 17 | 159 | 33 | 51 | 152 | 114 | 50 |
| Port Ludlow | ... | 14 | 155 | 31 | 50 | 148 | 111 | 46 |
| Port Townsend | 14 | ... | 143 | 39 | 58 | 136 | 97 | 31 |
| Point Wilson | 16 | 3 | 140 | 40 | 60 | 133 | 95 | 30 |
| Powell River, B. C. | 155 | 143 | ... | 180 | 198 | 24 | 73 | 126 |
| Seattle | 31 | 39 | 180 | ... | 24 | 173 | 135 | 68 |
| Stellacoom | 60 | 69 | 203 | 35 | 16 | 201 | 130 | 98 |
| Tacoma | 50 | 58 | 193 | 24 | ... | 191 | 155 | 68 |
| Union Bay, B. C. | 148 | 136 | 24 | 173 | 191 | ... | 77 | 125 |
| Vancouver, B. C. | 111 | 97 | 73 | 135 | 155 | 77 | ... | 84 |
| Victoria, B. C. | 46 | 31 | 126 | 68 | 68 | 125 | 84 | ... |
| Possession Point | 13 | 20 | 160 | 19 | 39 | 154 | 116 | 52 |

Nautical
Miles

| | |
|--|-----|
| Ocean Falls, Vancouver Island, B. C., to Port Townsend | 372 |
| Ocean Falls, Vancouver Island, B. C., to Seattle, Wash. | 410 |
| Port Alberni, Vancouver Island, B. C., to Victoria, B. C. | 130 |

TABLE OF DISTANCES

ACAPULCO

| Acapulco, Mexico, to— | Route— | Nautical Miles |
|---------------------------------------|--------|----------------|
| Antofagasta, Chile | | 2,984 |
| Arica, Chile | | 2,768 |
| Caldera, Chile | | 3,130 |
| Callao, Peru | | 2,198 |
| Coquimbo, Chile | | 3,259 |
| Corinto, Nicaragua | | 792 |
| Esmeraldas, Ecuador | | 1,527 |
| Guayaquil, Ecuador | | 1,708 |
| Honolulu, Hawaii | | 3,289 |
| Iquique, Chile | | 2,834 |
| Lota, Chile | | 3,573 |
| Magdalena Bay, Mexico | | 853 |
| Mollendo, Peru | | 2,643 |
| Pacasmayo, Peru | | 1,895 |
| Paita, Peru | | 1,725 |
| Panama, C. Z. | | 1,426 |
| Pichilínque Harbor (U. S. coal depot) | | 778 |
| Mexico. | | |
| Pisco, Peru | | 2,309 |
| Punta Arenas, Chile | | 4,582 |
| Punta Arenas, Costa Rica | | 1,011 |
| Salina Cruz, Mexico | | 314 |
| San Jose, Guatemala | | 574 |
| Tahiti (Papeete), Society Is. | | 3,595 |
| Talcahuano, Chile | | 3,558 |
| Valdivia (Port Corral), Chile | | 3,712 |
| Valparaíso, Chile | | 3,406 |

ASTORIA

| Astoria to— | Nautical Miles |
|----------------------|----------------|
| Columbia River Bar | 10 |
| Dutch Harbor, Alaska | 1,688 |
| Grays Harbor Bar | 53 |
| Port Townsend, Wash. | 214 |
| San Francisco | 555 |
| Seattle, Wash. | 252 |
| Tacoma, Wash. | 279 |
| Tatoosh, Wash. | 126 |
| Willapa Bar | 38 |

INLAND WATERS

ASTORIA

DISTANCES FROM ASTORIA, ORE., TO COLUMBIA RIVER AND WILLAMETTE RIVER LOADING POINTS

The distances are from Astoria at a point known as the Mack Dock, where all bearings are taken. The Portland distance terminates at the Steel Bridge.

| | Statute Miles |
|--------------------|---------------|
| Knappton, Wash. | 12 |
| Wauna, Ore. | 28 |
| Westport, Ore. | 30 |
| Oak Point, Wash. | 40 |
| Stella, Wash. | 42½ |
| Rainier, Ore. | 54½ |
| Prescott, Ore. | 57 |
| Goble, Ore. | 60 |
| Kalama, Wash. | 60 |
| Saint Helens, Ore. | 73 |
| Linnton, Ore. | 92½ |
| Vancouver, Wash. | 94 |
| Saint Johns, Ore. | 95 |
| Portland, Ore. | 100 |

To facilitate the loading and unloading of vessels the Port of Astoria has a 50-ton movable crane and bunkers that hold 20,000 tons of coal.

BORDEAUX

| Bordeaux, France, to— | Route— | Nautical Miles |
|--------------------------------|---------------------------------------|-------------------|
| Acapulco, Mexico | Via Panama Canal | 6,067 |
| Do | Via Magellan Strait | 11,651 |
| Aden, Arabia | Via Suez Canal | 4,351 |
| Callao, Peru | Via Panama Canal | 5,987 |
| Do | Via Magellan Strait | 9,740 |
| Colon, C. Z. | Via Mona Passage | 4,598 |
| Coronel, Chile | Via Panama Canal | 7,463 |
| Do | Via Magellan Strait | 8,262 |
| Guayaquil (Puna), Ecuador | Via Panama Canal | 5,434 |
| Do | Via Magellan Strait | 10,342 |
| Habana, Cuba | Via NE. Providence Channel | 4,188 |
| Honolulu, Hawaii | Via Panama Canal | 9,326 |
| Do | Via Magellan Strait | 13,439 |
| Iquique, Chile | Via Panama Canal | 6,628 |
| Do | Via Magellan Strait | 9,270 |
| Panama, C. Z. | Via Mona Passage | 4,641 |
| Pernambuco, Brazil | | 3,823 |
| Portland, Oreg., U. S. A. | Via Panama Canal and San Francisco | 8,536 |
| Do | Via Magellan Strait and San Francisco | 13,912 |
| Port Townsend, Wash., U. S. A. | Via Panama Canal and San Francisco | 8,656 |
| Do | Via Magellan Strait and San Francisco | 14,032 |
| Punta Arenas, Chile | East of South America | 7,074 |
| Do | Via Panama Canal | 8,584 |
| San Diego, Cal., U. S. A. | do | 7,484 |
| Do | Via Magellan Strait | 12,870 |
| San Francisco, Cal., U. S. A. | Via Panama Canal | 7,886 |
| Do | Via Magellan Strait | 13,262 |
| San Jose, Guatemala | Via Panama Canal | 5,527 |
| Do | Via Magellan Strait | 11,365 |
| Sitka, Alaska | Via Panama Canal and San Francisco | 9,188 |
| Do | Via Magellan Strait and San Francisco | 14,564 |
| Valparaiso, Chile | Via Panama Canal | 7,257 |
| Do | Via Magellan Strait | 8,507 |
| Vancouver, B. C. | Via Panama Canal | 8,673 |
| Do | Via Magellan Strait | 14,047 |

BREST

| Brest, France, to— | Route— | Nautical Miles |
|----------------------------------|--|-------------------|
| Colon, C. Z. | Via Mona Passage | 4,420 |
| Gravesend, England | | 392 |
| Guantanamo Bay (Calmanera), Cuba | | 3,791 |
| New York (The Battery), N. Y. | Winter; westbound | 2,994 |
| U. S. A. | | |
| Do | Summer; westbound | 3,072 |
| Rio de Janeiro, Brazil | | 4,841 |
| San Francisco, Cal., U. S. A. | Via Rio de Janeiro and Magellan Strait | 13,271 |
| Do | Via Mona Passage and Panama | 7,708 |

BUENOS AIRES

| Buenos Aires, Argentina, to— | Route— | Nautical Miles |
|--|------------------------|-------------------|
| Asuncion, Paraguay | | 827 |
| Colon, C. Z. | North of South America | 5,450 |
| Los Angeles Hbr. (San Pedro), Cal., U. S. A. | Via Panama Canal | 8,406 |
| Punta Arenas, Chile | | 1,383 |
| Rosario, Argentina | | 210 |
| Southampton, England | | 5,762 |

CALLAO

| Callao, Peru, to— | Route— | Nautical Miles |
|---|--------|-------------------|
| Antofagasta, Chile | | 813 |
| Arica, Chile | | 593 |
| Caldera, Chile | | 980 |
| Chimbote, Peru | | 206 |
| Coquimbo, Chile | | 1,136 |
| Honolulu, Hawaii | | 5,161 |
| Iquique, Chile | | 659 |
| Los Angeles Harbor (San Pedro), Cal. | | 3,655 |
| U. S. A. | | |
| Lota, Chile | | 1,530 |
| Magdalena Bay, Mexico | | 3,008 |
| Mollendo, Peru | | 468 |
| Panama, C. Z. | | 1,346 |
| Pisco, Peru | | 128 |
| Punta Arenas, Chile | | 2,671 |
| Talcahuano, Chile | | 1,508 |
| Valdivia (P. Corral), Chile | | 1,691 |
| Valparaiso, Chile | | 1,306 |

COLON

| Colon, Canal Zone, to— | Route— | Nautical Miles |
|---|---|-------------------|
| Apalachicola, Fla., U. S. A. | | 1,287 |
| Balboa, C. Z. | | 38 |
| Baltimore, Mr., U. S. A. | Via Windward and Crooked I. Passages | 1,901 |
| Barbados (Bridgetown), W. I. | | 1,237 |
| Bishops Rock, England | Via Anegada Passage | 4,395 |
| Bishops Rock, England | Via Mona Passage | 4,356 |
| Bluefields, Nicaragua | | 276 |
| Bocas del Toro, Panama | | 144 |
| Bordeaux, France | Via Mona Passage | 4,598 |
| Boston, Mass., U. S. A. | Via Windward and Crooked I. Passages; outside Nantucket Lightvessel. | 2,157 |
| Brunswick, Ga., U. S. A. | Via Windward and Crooked I. Passages | 1,550 |
| Buenos Aires, Argentina | North of South America | 5,450 |
| Campeche, Mexico | | 1,167 |
| Cape Haitien, Haiti | | 817 |
| Carmen, Mexico | | 1,246 |
| Cartagena, Colombia | | 281 |
| Ceiba, Honduras | | 666 |
| Charleston, S. C., U. S. A. | Via Windward and Crooked I. Passages | 1,564 |
| Charleston, S. C., U. S. A. | Via Yucatan Channel; northbound | 1,636 |
| Culebra I. (The Sound), W. I. | Outside Crab I. and via South Channel | 1,918 |
| Curacao (Santa Ana Harbor), W. I. | | 699 |
| Fort de France, Martinique, W. I. | | 1,159 |
| Galveston, Tex., U. S. A. | | 1,493 |
| Gibraltar | Via St. Thomas | 4,343 |
| Do | Via Anegada Passage | 4,332 |
| Gibraltar, Strait of (lat. 35° 57' N. long. 5° 45' W.) | do. | 4,308 |
| Glasgow, Scotland | Via Mona Passage | 4,523 |
| Gracias a Dios, Nicaragua | | 399 |
| Grijalva (Tabasco) River, Mexico | | 1,280 |
| Guantanamo Bay (Calmanera), Cuba. | | 696 |
| Gulfport, Miss., U. S. A. | Northbound | 1,388 |
| Habana, Cuba | Via Yucatan Channel | 1,003 |
| Halifax, Nova Scotia | Via Windward and Crooked I. Passages | 2,317 |
| Hamburg, Germany | Via Mona Passage | 5,070 |
| Hampton Roads, Va., U. S. A. | Via Windward and Crooked I. Passages | 1,768 |
| Havre, France | Via Mona Passage | 4,614 |
| Horn I. Arch., Gulf of Mexico | Northbound | 1,373 |
| Hull, England | Via Mona Passage | 4,884 |
| Iriona, Honduras | | 566 |
| Jacksonville, Fla., U. S. A. | Via Yucatan Channel; northbound | 1,535 |
| Key West, Fla., U. S. A. | | 1,065 |
| Kingston, Jamaica, W. I. | | 551 |
| La Guaira, Venezuela | | 841 |
| Liverpool, England | Via Mona Passage | 4,548 |

COLON—Continued

| Colon, C. Z., to— | Route— | Nautical Miles |
|--|---|-------------------|
| Livingston, Guatemala | | 772 |
| Los Angeles, Hbr. (San Pedro), Cal., U. S. A. | | 2,956 |
| Margarita I. (La Mar Bay), Venezuela. | | 1,012 |
| Matagorda Bay (Entr.), Tex., U. S. A. | | 1,515 |
| Mississippi River (South Pass; lat. 28° 59' N., long. 89° 07' W.). | Northbound | 1,308 |
| Mississippi River (S. W. Pass; lat. 28° 53' N., long. 89° 27' W.). | do | 1,309 |
| Mobile, Ala., U. S. A. | do | 1,393 |
| Mona Passage (lat. 18° 03' N., long. 67° 47' W.), W. I. | | 880 |
| Monkey Pt. Hbr., Nicaragua | | 259 |
| New Orleans, La., U. S. A. | Northbound; via South Pass | 1,403 |
| Do | Northbound; via S. W. Pass | 1,419 |
| New York (The Battery), N. Y., U. S. A. | Via Windward and Crooked I. Passages | 1,974 |
| Newport, R. I., U. S. A. | do | 2,028 |
| Newport News, Va., U. S. A. | do | 1,776 |
| Norfolk, Va., U. S. A. | do | 1,779 |
| Do | Via Yucatan Channel; northbound | 2,006 |
| Panama Roads, C. Z. | Via Panama Canal | 43 |
| Pensacola, Fla., U. S. A. | Northbound | 1,369 |
| Philadelphia, Pa., U. S. A. | Via Windward and Crooked I. Passages | 1,946 |
| Plymouth, England | Via St. Thomas | 4,500 |
| Do | Via Mona Passage | 4,455 |
| Do | Via Anegada Passage | 4,494 |
| Port Arthur, Tex. | | 1,485 |
| Port Castries, St. Lucia, W. I. | | 1,160 |
| Port Limon, Costa Rica | | 192 |
| Port Morelos, Yucatan | | 828 |
| Port of Spain, Trinidad, W. I. | Via Windward and Crooked I. Passages | 1,159 |
| Port Royal, Jamaica, W. I. | | 546 |
| Port Tampa, Fla., U. S. A. | | 1,212 |
| Portsmouth, N. H., U. S. A. | Via Windward and Crooked I. Passages outside Nantucket Lightvessel. | 2,174 |
| Provincetown, Mass., U. S. A. | Via Windward and Crooked I. Passages | 2,126 |
| Puerto Barrios, Guatemala | | 780 |
| Puerto Cabello, Venezuela | | 802 |
| Puerto Cortes, Honduras | | 733 |
| Puerto Mexico, Mexico | | 1,377 |
| Rio de Janeiro, Brazil | | 4,348 |
| Rio Grande (Entr.) | | 1,484 |
| Roatan Island (Coxen Hole) | | 641 |
| Sabine, Tex., U. S. A. | | 1,476 |
| St. Thomas, W. I. | | 1,029 |
| San Juan, P. R. | | 893 |
| Sandy Hook, N. J., U. S. A. | Via Windward and Crooked I. Passages | 1,964 |
| Savannah, Ga., U. S. A. | Via Yucatan Channel! northbound | 1,607 |
| Southport, N. C., U. S. A. | Via Windward and Crooked I. Passages | 1,592 |
| Tampico, Mexico | | 1,485 |
| Tela, Honduras | | 706 |
| Trinidad (Dragons Mouths; lat 10° 43' N., long. 61° 45' W.), W. I. | | 1,142 |
| Trujillo, Honduras | | 622 |
| Tuxpam, Mexico | | 1,455 |
| Vera Cruz, Mexico | | 1,420 |
| Virgin Passage (lat. 18° 20' N., long. 65° 07' W.), W. I. | | 1,021 |
| Wilmington, N. C., U. S. A. | Via Yucatan Channel; northbound | 1,730 |
| Windward Passage (lat. 20° 10' N., long. 74° 30' W.), W. I. | | 734 |
| Yucatan Channel (lat. 21° 50' N., long. 85° 03' W.). | | 812 |

EUREKA

| Eureka, Humboldt Bay, California, U. S. A. to— | Route— | Nautical Miles |
|---|--------------------|-------------------|
| Astoria, Oregon | | 343 |
| Bellingham, Wash. | | 594 |
| Cape Flattery, Wash. | | 464 |
| Coos Bay, Oregon. | | 159 |
| Grays Harbor, Wash., "Whistle Buoy." | | 371 |
| Honolulu, Hawaii | | 2,139 |
| Los Angeles Harbor (San Pedro), Cal. | | 584 |
| Manilla, P. I. | Via Honolulu | 6,906 |
| Panama Roads, Canal Zone | | 3,461 |
| Port Townsend, Wash. | | 548 |
| San Francisco, Cal. | | 216 |
| San Diego, Cal. | | 668 |
| Seattle, Wash. | | 588 |
| Tacoma, Wash. | | 610 |
| Union Bay, B. C. | | 659 |
| Vancouver, B. C. | | 617 |
| Victoria, B. C. | | 534 |
| Willapa Harbor, Wash., "Whistle Buoy." | | 355 |

GIBRALTAR

| Gibraltar to— | Route— | Nautical Miles |
|---|---|-------------------|
| Acapulco, Mexico | Via Anegada Passage and Panama Canal | 5,801 |
| Do | Via Magellan Strait | 10,960 |
| Aden, Arabia ..... | ..... | 3,321 |
| Alexandria, Egypt ..... | ..... | 1,810 |
| Algiers, Algeria ..... | ..... | 425 |
| Barcelona, Spain ..... | ..... | 516 |
| Callao, Peru | Via Anegada Passage and Panama Canal | 5,721 |
| Do | Via Magellan Strait | 9,049 |
| Colon, C. Z. | Via Anegada Passage | 4,332 |
| Do | Via St Thomas, W. I. | 4,343 |
| Constantinople, Turkey | Via Messina Strait and Corinth Canal | 1,823 |
| Do | Via South of Sicily and Cervi and Duro Channels. | 1,824 |
| Coronel, Chile | Via Anegada Passage and Panama Canal | 7,197 |
| Do | Via Magellan Strait | 7,571 |
| Fayal (Horta), Azores ..... | ..... | 1,133 |
| Genoa, Italy ..... | ..... | 860 |
| Guayaquil (Puna), Ecuador | Via Anegada Passage and Panama Canal | 5,168 |
| Do | Via Magellan Strait | 9,651 |
| Hongkong | Via Anegada Passage and Panama Canal | 13,570 |
| Do | Via Suez Canal | 8,409 |
| Honolulu, Hawaii | Via Anegada Passage and Panama Canal | 9,060 |
| Do | Via Magellan Strait | 12,748 |
| Iquique, Chile | Via Anegada Passage and Panama Canal | 6,362 |
| Do | Via Magellan Strait | 8,579 |
| Lisbon, Portugal ..... | ..... | 304 |
| Liverpool, England ..... | ..... | 1,294 |
| Livorno, (Leghorn), Italy ..... | ..... | 875 |
| London, England ..... | ..... | 1,251 |
| Malta (Valetta Hbr.) ..... | ..... | 990 |
| Manila, P. I. | Via Anegada Passage, Panama Canal, and San Bernardino Strait. | 13,745 |
| Do | Via Anegada Passage, Panama Canal and Balintang Channel. | 13,722 |
| Do | Via Suez, Aden, Colombo, Singapore... S. of Sokotra I. | 8,372 |
| Marseille, France ..... | ..... | 693 |
| Naples, Italy ..... | ..... | 982 |
| New York (The Battery); N. Y., U. Winter; westbound ..... | ..... | 3,201 |
| S. A. .... | ..... | ..... |
| Do | Summer; westbound | 3,207 |
| Odessa, Russia | Via Messina Strait and Corinth Canal | 2,170 |
| Do | Via South of Sicily and Cervi and Duro Channels. | 2,171 |

GIBRALTAR—Continued

| Gibraltar to— | Route— | Nautical Miles |
|-------------------------------------|--|-------------------|
| Panama, C. Z. | Via Anegada Passage | 4,375 |
| Plymouth, England ..... | ..... | 1,060 |
| Port Said, Egypt ..... | ..... | 1,925 |
| Port Townsend, Wash., U. S. A. | Via Anegada Passage, Panama Canal and San Francisco. | 8,390 |
| Do | Via Magellan Strait and San Francisco | 13,341 |
| Portland, Ore, U. S. A. | Via Anegada Passage, Panama Canal and San Francisco. | 8,270 |
| Do | Via Magellan Strait and San Francisco | 13,221 |
| Punta Arenas, Chile ..... | ..... | 6,383 |
| San Diego, Cal. | Via Anegada Passage and Panama Canal | 7,213 |
| Do | Via Magellan Strait | 12,179 |
| San Francisco, Cal. | Via Anegada Passage and Panama Canal | 7,620 |
| Do | Via Magellan Strait | 12,571 |
| San Jose, Guatemala | Via Anegada Passage and Panama Canal | 5,261 |
| Do | Via Magellan Strait | 10,674 |
| Sfax, Tunis ..... | ..... | 1,060 |
| Sitka, Alaska | Via Anegada Passage, Panama Canal, and San Francisco. | 8,922 |
| Do | Via Magellan Strait and San Francisco | 13,873 |
| Smyrna, Turkey | Via Messina Strait and Corinth Canal | 1,672 |
| Do | Via South of Sicily and Cervi and Duro Channels. | 1,676 |
| Sydney, Australia | Via Panama and Tahiti | 12,169 |
| Do | Via Suez Canal | 10,237 |
| Toulon, France ..... | ..... | 705 |
| Trieste, Austria-Hungary ..... | ..... | 1,693 |
| Tripoli, Tripoli ..... | ..... | 1,118 |
| Valparaiso, Chile | Via Anegada Passage and Panama Canal | 6,991 |
| Do | Via Magellan Strait | 7,816 |
| Vancouver, B. C. | Via Anegada Passage and Panama Canal | 8,407 |
| Do | Via Magellan Strait | 13,356 |
| Wellington, New Zealand | Via Anegada Passage, Panama Canal, and Tahiti. | 11,209 |
| Do | Via Suez Canal | 11,156 |
| Yokohama, Japan | Via Anegada Passage and Panama Canal | 12,057 |
| Do | Via Anegada Passage, Panama Canal, and San Francisco. | 12,156 |
| Do | Via Suez, Hongkong, Shanghai, and Van Diemen Strait. | 10,302 |
| Do | Via Suez, Aden, Colombo, and Singapore | 9,907 |
| Do | Via Suez Canal | 9,859 |

GRAYS HARBOR

| Grays Harbor, Wash., "Whistle Buoy," to— | Route— | Nautical Miles |
|--|--------------------|-------------------|
| Astoria, Oregon | | 53 |
| Eureka, Humboldt Bay | | 371 |
| Honolulu, Hawaii | | 2,281 |
| Los Angeles Harbor, (San Pedro), Cal. | | 972 |
| Manila | Via Honolulu | 7,084 |
| Port Townsend, Wash. | | 179 |
| San Francisco, Cal. | | 604 |
| Seattle, Wash. | | 218 |
| Tacoma, Wash. | | 243 |
| Vancouver, B. C. | | 232 |
| Victoria, B. C. | | 155 |
| Willapa Harbor, Wash., "Whistle Buoy" | | 15½ |

HONOLULU

| Honolulu, Hawaii, to— | Route— | Nautical Miles |
|---|--|----------------|
| Astoria, Ore., U. S. A. | | 2,246 |
| Auckland, New Zealand | | 3,820 |
| Brisbane Roads, Australia | | 4,169 |
| Callao, Peru | | 5,161 |
| Cape Horn, South America | | 6,472 |
| Chimbote, Peru | | 5,015 |
| Christmas I., N. Pacific Ocean | | 1,161 |
| Dutch Harbor, Unalaska I., Alaska | | 2,046 |
| Fanning Island | | 1,056 |
| Gaum (Port Apra), Marianas | | 3,337 |
| Do | Via Tarawa I., Gilbert Is. | 3,944 |
| Gulf of Fonseca (Monypenny Pt.) Nicaragua | | 4,038 |
| Hobart, Tasmania | | 4,930 |
| Hongkong | Rhumb | 4,939 |
| Jaluit, Marshal I. | | 2,096 |
| Johnston I., Hawaii | | 717 |
| Juan Fernandez I. (San Juan Bautista Bay) | | 5,595 |
| Kusaie I., Caroline I. | | 2,467 |
| Laysan Island, H. I. | | 820 |
| Levuka, Fiji I. | | 2,730 |
| Los Angeles Harbor (San Pedro), Cal., U. S. A. | | 2,228 |
| Magdalena Bay, Mexico | | 2,543 |
| Manila, P. I. | Via north end of Luzon, P. I. | 4,869 |
| Do | Via Guam and north end of Luzon, P. I. | 5,079 |
| Do | Via Guam and San Bernardino Strait | 4,838 |
| Do | Via San Bernardino Strait | 4,767 |
| Marquesas Is., Nukuhiva (Taiohae) | | 2,102 |
| Marshal Is. (Eniwetok Atoll) | | 2,375 |
| Melbourne, Australia | Via South Channel | 4,942 |
| Midway Is. (Welles Hbr.) | | 1,149 |
| New Hebrides (St. Philip and St. James Bay) | | 3,014 |
| New York (The Battery), N. Y., U. S. A. | Via Magellan Strait | 13,312 |
| Do | Via Panama Canal, and Windward and Crooked I. Passages. | 6,702 |
| Nonuti, Gilbert Is. | | 2,100 |
| Noumea, New Caledonia | | 3,373 |
| Nukunono, Union Is. | | 2,109 |
| Pago Pago, Samoa Is. | | 2,276 |
| Panama, C. Z. | | 4,685 |
| Pelew Is. (Korror Hbr.) | | 3,997 |
| Petropavlovsk, Kamchatka | | 2,762 |
| Point Conception, Cal., U. S. A. | | 2,126 |
| Ponape, Caroline Is. | | 2,685 |
| Port Lloyd, Ogasawara Is. | | 3,283 |
| Port Townsend, Wash., U. S. A. | | 2,366 |
| Portland, Ore., U. S. A. | | 2,332 |
| Punta Arenas, Chile | | 6,370 |
| Raoul Is., Kermadec Is. | | 3,246 |
| Rarotonga, Cook Is. | | 2,553 |
| Salina Cruz, Mexico | | 3,580 |
| San Bernardino Strait (Entr.), P. I. | | 4,457 |
| San Diego, Cal., U. S. A. | | 2,278 |
| San Francisco, Cal., U. S. A. | | 2,091 |
| Sandakan, Borneo | | 5,044 |
| Seattle, Wash., U. S. A. | | 2,409 |
| Sitka, Alaska | | 2,386 |
| Sydney, Australia | | 4,420 |
| Tahiti (Papeete), Society Is. | | 2,381 |
| Tarawa Island, Gilbert Is. | | 2,190 |
| Tongatabu (Nukualofa), Tonga Is. | | 2,749 |
| Ugi Is. (Selwyn Bay), Solomon Is. | | 3,047 |
| Valparaiso, Chile | | 5,919 |
| Vancouver, B. C. | | 2,423 |
| Victoria, British Columbia | | 2,349 |
| Vladivostok, Siberia | | 3,725 |
| Wake Island | | 2,004 |
| Wellington, New Zealand | | 4,113 |
| Yap (Tomill Hbr.), Caroline Is. | | 3,757 |
| Yokohama, Japan | Rhumb | 3,445 |
| Do | Great Circle | 3,394 |

IQUIQUE

| Iquique, Chile, to— | Route— | Nautical Miles |
|-----------------------------------|------------------|-------------------|
| Antofagasta, Chile | | 224 |
| Caldera, Chile | | 420 |
| Coquimbo, Chile | | 602 |
| Lota, Chile | | 1,033 |
| Punta Arenas, Chile | | 2,201 |
| Talcahuano, Chile | | 1,008 |
| Valdivia (P. Corral), Chile | Via Panama Canal | 1,205 |
| Valparaiso, Chile | | 782 |
| Yokohama, Japan | | 9,026 |

LIVERPOOL

| Liverpool, England, to— | Route— | Nautical Miles |
|---------------------------------|--|-------------------|
| Acapulco, Mex. | Via Panama Canal | 6,017 |
| Do | Via Magellan Strait | 11,891 |
| Adelaide, Australia | Via Panama, Tahiti, Sydney, and Melbourne. | 13,478 |
| Do | Via Suez Canal, Aden, Colombo, and King George Sound. | 11,108 |
| Baltimore, Md., U. S. A. | Winter; westbound | 3,373 |
| Do | Summer; westbound | 3,454 |
| Boston, Mass., U. S. A. | Winter; westbound | 2,895 |
| Do | Summer; westbound | 3,010 |
| Callao, Peru | Via Panama Canal | 5,937 |
| Do | Via Magellan Strait | 9,980 |
| Colon, C. Z. | Via Mona Passage | 4,548 |
| Coronel, Chile | Via Panama Canal | 7,413 |
| Do | Via Magellan Strait | 8,502 |
| Galveston, Tex., U. S. A. | Winter; westbound; via NE. Providence Channel and south of Dry Tortugas. | 4,749 |
| Do | Summer; westbound; via NE. Providence Channel and south of Dry Tortugas. | 4,766 |
| Gibraltar | | 1,294 |
| Guayaquil (Puna), Ecuador | Via Panama Canal | 5,384 |
| Do | Via Magellan Strait | 13,582 |
| Hongkong | Via Panama and direct | 13,764 |
| Do | Via Panama, San Francisco, and Yokohama. | 13,957 |
| Do | Via Suez Canal, Aden, Colombo, and Singapore. | 9,743 |
| Do | Via Magellan Strait, Pago Pago, and Guam. | 17,432 |
| Honolulu, Hawaii | Via Panama Canal | 9,276 |
| Do | Via Magellan Strait | 13,679 |
| Iquique, Chile | Via Panama Canal | 6,578 |
| Do | Via Magellan Strait | 9,510 |
| Las Palmas, Canary Is. | | 1,661 |
| Manila, P. I. | Via Magellan Strait, Pago Pago, and Guam. | 17,111 |
| Do | Via Panama Canal and San Bernardino Strait. | 13,961 |
| Do | Via Panama, San Francisco, and Yokohama. | 14,129 |
| Do | Via Suez Canal, Aden, Colombo, and Singapore. | 9,659 |
| Do | Via Suez Canal, Colombo, and Singapore. | 9,649 |

LIVERPOOL—Continued

| Liverpool, England, to— | Route— | Nautical Miles |
|---|---|----------------|
| Melbourne, Australia | Via Cape of Good Hope | 12,137 |
| Do | Via Cape Town | 12,157 |
| Do | Via Panama Canal | 12,519 |
| Do | Via Suez Canal | 11,084 |
| Do | Via Panama, Tahiti, and Sydney | 12,966 |
| Do | Via Suez Canal, Aden, Colombo, King George Sound, and Adelaide | 11,620 |
| Mobile, Ala., U. S. A. | Winter; westbound; via NE. Providence Channel and south of Dry Tortugas | 4,520 |
| Do | Summer; westbound; via NE. Providence Channel and south of Dry Tortugas | 4,537 |
| New Orleans, La., U. S. A. | Winter westbound; via NE. Providence Channel, south of Dry Tortugas, and SW. Pass. | 4,589 |
| Do | Summer; westbound; via NE. Providence Channel, south of Dry Tortugas, and S.W. Pass. | 4,606 |
| New York (The Battery), N. Y. U. S. A. | Winter; westbound | 3,073 |
| Do | Summer; westbound | 3,171 |
| Newport News, Va., U. S. A. | Winter; westbound | 3,249 |
| Do | Summer; westbound | 3,330 |
| Panama, C. Z. | Via Mona Passage | 4,591 |
| Pensacola, Fla., U. S. A. | Winter; westbound; via NE. Providence Channel and south of Dry Tortugas | 4,480 |
| Do | Summer; westbound; via NE. Providence Channel and south of Dry Tortugas | 4,497 |
| Pernambuco, Brazil | Direct | 4,062 |
| Do | Via Scilly Is. (St. Marys Anch.) | 4,078 |
| Philadelphia, Pa., U. S. A. | Winter; westbound | 3,226 |
| Do | Summer; westbound | 3,324 |
| Port Nelson, Saskatchewan, Canada ..... | ..... | 3,009 |
| Port Townsend, Wash., U. S. A. | Via Panama and San Francisco | 8,606 |
| Do | Via Magellan Strait and San Francisco | 14,272 |
| Portland, Ore., U. S. A. | Via Panama and San Francisco | 8,486 |
| Do | Via Magellan Strait and San Francisco | 14,152 |
| Punta Arenas, Chile | Direct | 7,314 |
| Do | Via Scilly Is. (St. Marys Anch.) | 7,329 |
| St. Thomas, W. I. .... | ..... | 3,574 |
| San Diego, Cal., U. S. A. | Via Panama Canal | 7,434 |
| Do | Via Magellan Strait | 13,110 |
| San Francisco, Cal., U. S. A. | Via Panama Canal | 7,836 |
| Do | Via Magellan Strait | 13,502 |
| San Jose, Guatemala | Via Panama Canal | 5,477 |
| Do | Via Magellan Strait | 11,605 |
| Sitka, Alaska | Via Panama and San Francisco | 9,138 |
| Do | Via Magellan Strait and San Francisco | 14,804 |
| Sydney, Australia | Via Panama and Tahiti | 12,385 |
| Do | Via Suez Canal, Aden, Colombo, King George Sound, Adelaide, and Melbourne | 12,201 |
| Valparaiso, Chile | Via Panama Canal | 7,207 |
| Do | Via Magellan Strait | 8,747 |
| Vancouver, British Columbia | Via Panama Canal | 8,623 |
| Do | Via Magellan Strait | 14,287 |
| Vladivostok, Siberia | Via Suez Canal, Colombo, and Singapore | 11,282 |
| Wellington, New Zealand | Via Cape Town | 13,353 |
| Do | Via Panama Canal and direct | 11,096 |
| Do | Via Panama and Tahiti | 11,425 |
| Do | Via Suez Canal, Aden, Colombo, King George Sound, and Melbourne | 12,955 |
| Do | Via Suez Canal and direct | 12,462 |
| Yokohama, Japan | Via Magellan Strait and Pago Pago | 16,584 |
| Do | Via Panama Canal and direct | 12,273 |
| Do | Via Panama and San Francisco | 12,372 |
| Do | Via Suez Canal, Aden, Colombo, Singapore, Hongkong, and Shanghai | 11,636 |

LONDON

| London, England, to— | Route— | Nautical Miles |
|--|--|-------------------|
| Baltimore, Md., U. S. A. | Winter; westbound | 3,610 |
| Do | Summer; westbound | 3,681 |
| Bishops Rock (lat. 49° 50' N., long. 6° 27' W.). | | 407 |
| Boston, Mass., U. S. A. | Winter; westbound | 3,132 |
| Do | Summer; westbound | 3,237 |
| Cape Town, Africa | | 6,139 |
| Christiania, Norway | | 658 |
| Copenhagen, Denmark | | 704 |
| Gibraltar | | 1,351 |
| Havre, France | | 203 |
| Hongkong | Via Suez Canal | 9,749 |
| Lisbon, Portugal | | 1,062 |
| Melbourne, Australia | Via Panama | 12,734 |
| New York (The Battery), N. Y., U. S. A. | Winter; westbound | 3,310 |
| Do | Summer; westbound | 3,398 |
| Newport News, Va., U. S. A. | Winter; westbound | 3,486 |
| Do | Summer; westbound | 3,557 |
| Pernambuco, Brazil | | 4,136 |
| Petrograd, Russia | | 1,519 |
| Philadelphia, Pa., U. S. A. | Winter; westbound | 3,463 |
| Do | Summer; westbound | 3,551 |
| Plymouth, England | | 321 |
| Port Arthur, Tex., U. S. A. | Winter; westbound; via N. E. Providence Channel and South of Dry Tortugas. | 4,963 |
| Do | Summer; westbound; via N. E. Providence Channel and South of Dry Tortugas. | 4,970 |
| Southampton, England | | 215 |
| Stockholm, Sweden | | 1,251 |
| Sydney, Australia | Via Cape of Good Hope | 12,663 |
| Do | Via Suez Canal | 11,603 |
| Tornea, Russia | | 1,659 |

LOS ANGELES HARBOR (San Pedro)

| Los Angeles Harb. (San Pedro), Cal., U. S. A., to— | Route— | Miles Nautical |
|--|---|-------------------|
| Buenos Aires, Argentina | Via Panama Canal | 8,436 |
| Callao, Peru | | 3,655 |
| Colon, C. Z. | Via Panama Canal | 2,956 |
| Honolulu, Hawaii | | 2,228 |
| Manila, P. I. | Via Honolulu and San Bernardino Strait. | 6,995 |
| Do | Via San Bernardino Strait | 6,588 |
| Panama, C. Z. | | 2,913 |
| Portland, Ore., U. S. A. | | 989 |
| Rio de Janeiro, Brazil | Via Panama Canal | 7,305 |
| Salina Cruz, Mexico | | 1,802 |
| San Diego, U. S. A. | | 97 |
| San Francisco, Cal., U. S. A. | | 368 |
| Santa Cruz, Cal., U. S. A. | | 295 |
| Valparaiso, Chile | | 4,808 |
| Victoria, B. C. | | 1,091 |
| Yokohama, Japan | | 4,839 |

MANILA

| Manila, P. I., to— | Route— | Nautical Miles |
|---|--|-------------------|
| Batavia, Java | Via Palawan Passage | 1,559 |
| Borongan, Samar, P. I. .... | ..... | 435 |
| Bremen, Germany | Via Suez Canal and Singapore | 9,955 |
| Brisbane Roads, Australia | Via Mindoro and Torres Straits and in- side route. | 3,552 |
| Cairns, Australia | do. | 2,723 |
| Cebu, P. I. | Via Verde I. and Jintotolo Passages | 391 |
| Colombo, Ceylon ..... | ..... | 2,952 |
| Friederich Wilhelmshafen, Papua | Via San Bernardino Strait | 2,011 |
| Guam (Port Apa), Marianas | Via north end of Luzon, P. I. | 1,742 |
| Do | Via San Bernardino Strait | 1,501 |
| Honolulu, Hawaii | Via north end of Luzon, P. I. | 4,869 |
| Do | Via San Bernardino Strait | 4,767 |
| Do | Via north end of Luzon, P. I. and Guam | 5,079 |
| Iloilo, P. I. | Via Verde I. and Jintotolo Passages ... | 361 |
| Jolo, Jolo I., P. I. | Via West Apo Channel | 550 |
| Limay, Luzon, P. I. .... | ..... | 22 |
| Liverpool, England | Via Singapore, Colombo, and Suez Canal | 9,649 |
| Do | Via Guam, Pago Pago, and Magellan Strait. | 17,111 |
| London, England | Via Suez Canal | 9,656 |
| Mangarin, Mindoro, P. I. .... | ..... | 170 |
| Melbourne, Australia | Via Mindoro and Torres Straits and in- side route. | 4,528 |
| Moji, Japan ..... | ..... | 1,436 |
| Newcastle, Australia | Via Mindoro and Torres Straits and in- side route. | 3,917 |
| Olongapo, Luzon, P. I. .... | ..... | 64 |
| Pago Pago, Samoa Is. | Via San Bernardino Strait | 4,505 |
| Panama, C. Z. | Via Balintang Channel and Cape San Lucas. | 9,347 |
| Do | Via San Bernardino Strait | 9,370 |
| Pelew Is. (Korror Hbr.) | Via Verde I. Passage and between Ma- ranjos Gr. and Copul I. | 1,044 |
| Port Darwin, Australia | Via Mindoro, Basilan, Banka, and Mani- pa Straits. | 1,834 |
| Port Townsend, Wash., U. S. A. | Composite Great Circle | 5,931 |
| Rabaul, Neu Pommern | Via San Bernardino Strait | 2,281 |
| Saigon, Cochín-China ..... | ..... | 907 |
| San Francisco, Cal., U. S. A. | Via Balintang Channel | 6,221 |
| Do | Via San Bernardino Strait | 6,301 |
| Seattle, Wash., U. S. A. | Via Yokohama | 6,012 |
| Do | Via San Bernardino Strait, Guam, and Honolulu. | 7,247 |
| Singapore, Straits Settlements ..... | ..... | 1,370 |
| Southampton, England | Via Singapore and Suez Canal | 9,488 |
| Sydney, Australia | Via Mindoro and Torres Straits and in- side route. | 3,967 |
| Torres Strait (Thursday Island) | Via Mindoro Strait | 2,227 |
| Townsville, Australia | Via Mindoro and Torres Straits and in- side route. | 2,881 |
| Wake Island | Via San Bernardino Strait | 2,772 |
| Wyndham, Australia | Via Mindoro, Basilan, Banka, and Mani- pa Straits. | 1,982 |
| Yap I. (Tomill Hbr.), Caroline Is. | Via San Bernardino Strait | 1,154 |
| Yokohama, Japan | Via Balintang Channel | 1,757 |
| Do | Via Hongkong, Shanghai, Nagasaki, In- land Sea, and Kobe. | 2,683 |
| Zamboanga, Mindanao, P. I. | Via East Apo Channel | 532 |

NEWPORT NEWS, VA., U. S. A.

As the distance between Newport News, Va., and Norfolk, Va., is only three miles, use the Norfolk table as it is close enough for all practical purposes.

NORFOLK

| Norfolk, Va., U. S. A., to— | Route— | Nautical Miles |
|---|--|----------------|
| Acapulco, Mexico | Via Panama Canal | 3,248 |
| Do | Via Magellan Strait | 11,476 |
| Adelaide, Australia | Via Panama, Tahiti, Sydney, and Melbourne. | 10,709 |
| Do | Via St. Vincent and Cape Town | 12,709 |
| Baltimore, Md., U. S. A. | Great Circle C. Charles Light-vessel to C. St. Vincent. | 172 |
| Barcelona, Spain | Great Circle C. Charles Light-vessel to C. St. Vincent. | 3,881 |
| Belize, British Honduras | Via Straits of Florida; south-bound; outside. | 1,503 |
| Bocas, del Toro, Panama | Via Crooked I. and Windward Passages | 1,853 |
| Boston, Mass., U. S. A. | Via Vineyard Sound and Pollock Rip Slue. | 518 |
| Bremen, Germany | Winter, eastbound | 3,763 |
| Do | Summer, eastbound | 3,877 |
| Buenos Aires, Argentina | Do | 5,824 |
| Callao, Peru | Via Panama Canal | 3,168 |
| Do | Via Magellan Strait | 9,565 |
| Cartagena, Colombia | Via Crooked I. and Windward Passages | 1,658 |
| Colombo, Ceylon | Great Circle C. Charles Light-vessel to C. St. Vincent. | 8,769 |
| Colon, C. Z. | Via Crooked I. and Windward Passages | 1,779 |
| Coronel, Chile | Via Magellan Strait | 8,087 |
| Do | Via Panama Canal | 4,644 |
| Genoa, Italy | Great Circle C. Charles Light-vessel to C. St. Vincent. | 4,222 |
| Georgetown, British Guiana | Do | 2,090 |
| Georgetown, S. C., U. S. A. | Do | 388 |
| Gibraltar | Great Circle, C. Charles Light-vessel to C. St. Vincent. | 3,369 |
| Guam (Port Apra), Marianas | Via Magellan Strait | 14,921 |
| Do | Via Panama Canal | 9,810 |
| Do | Via Suez Canal and Sunda Strait | 13,234 |
| Guayaquil (Puna), Ecuador | Via Panama Canal | 2,615 |
| Do | Via Magellan Strait | 10,167 |
| Habana, Cuba | Southbound; outside | 985 |
| Hampton Roads (off light), Va. | Do | 11 |
| U. S. A. | Do | Do |
| Hongkong | Via Panama, San Francisco, Yokohama, and Shanghai. | 11,496 |
| Do | Via Panama, Honolulu, Yokohama, and Shanghai. | 11,794 |
| Do | Via Panama, Honolulu, Guam, and Manila. | 11,976 |
| Do | Via Suez Canal, Colombo, and Singapore | 11,808 |
| Honolulu, Hawaii | Via Panama Canal | 6,507 |
| Do | Via Magellan Strait | 13,264 |
| Iquique, Chile | Via Panama Canal | 3,809 |
| Do | Via Magellan Strait | 9,095 |
| Key West, Fla., U. S. A. | Outside; southbound | 927 |
| Kingston, Jamaica | Via Crooked I. and Windward Passages | 1,279 |
| Liverpool, England | Winter, eastbound | 3,272 |
| Do | Summer, eastbound | 3,367 |
| Livingston, Guatemala | Via Straits of Florida; southbound; outside. | 1,595 |
| London, England | Winter, eastbound | 3,506 |
| Do | Summer, eastbound | 3,590 |
| Manila, P. I. | Via Panama, San Francisco, and Yokohama. | 11,366 |
| Do | Via Panama, Honolulu, Yokohama, Shanghai, and Hongkong. | 12,425 |
| Do | Via Panama, Honolulu, and Yokohama. | 11,658 |
| Do | Via Panama, Honolulu, and Guam. | 11,345 |
| Do | Via Suez Canal, Colombo, and Singapore | 11,724 |
| Melbourne, Australia | Via Panama, Tahiti, and Sydney | 10,197 |
| Do | Via St. Vincent, Cape Town, and Adelaide. | 13,221 |
| New York (The Battery), N. Y., U. S. A. | Do | 292 |
| Panama, C. Z. | Via Crooked I. and Windward Passages | 1,822 |
| Philadelphia, Pa., U. S. A. | Do | 260 |
| Port Antonio, Jamaica | Via Crooked I. and Windward Passages | 1,228 |
| Port Banes, Cuba | Via Crooked I. Passage | 1,018 |
| Port Limon, Costa Rica | Via Crooked I. and Windward Passages | 1,852 |
| Port Said, Egypt | Do | 5,287 |

NORFOLK—Continued

| Norfolk, Va., U. S. A., to— | Route— | Nautical Miles |
|---|---|----------------|
| Port Townsend, Wash., U. S. A. | Via Panama and San Francisco | 5,837 |
| Do | Via Magellan Strait and San Francisco | 13,857 |
| Portland, Ore., U. S. A. | Via Panama and San Francisco | 5,717 |
| Do | Via Magellan Strait and San Francisco | 13,737 |
| Preston, Cuba | Via Crooked I. Passage | 1,021 |
| Providence, R. I., U. S. A. .... | ..... | 393 |
| Puerto Barrios, Guatemala | Via Straits of Florida; southbound; out- side. | 1,603 |
| Puerto Cortes, Honduras |do..... | 1,568 |
| Punta Arenas, Chile | East of South America | 6,900 |
| Do | Via Panama Canal | 5,765 |
| Rio de Janeiro, Brazil ..... | ..... | 4,723 |
| Rotterdam, Netherlands | Winter, eastbound | 3,552 |
| Do | Summer, eastbound | 3,636 |
| St. Vincent (Porto Grande), C. Verde Islands ..... | ..... | 2,973 |
| San Diego, Cal., U. S. A. | Via Panama Canal | 4,665 |
| Do | Via Magellan Strait | 12,695 |
| San Francisco, Cal., U. S. A. | Via Panama Canal | 5,067 |
| Do | Via Magellan Strait | 13,087 |
| San Jose, Guatemala | Via Panama Canal | 2,708 |
| Do | Via Magellan Strait | 11,190 |
| San Juan del Norte (Greytown), Nicaragua. | Via Crooked I. and Windward Passages | 1,837 |
| Do | Via Straits of Florida, southbound; out- side. | 1,846 |
| Santa Marta, Colombia | Via Crooked I. and Windward Passages | 1,588 |
| Savannah, Ga., U. S. A. .... | ..... | 499 |
| Shanghai, China | Via Panama, San Francisco, and Tsu- garu Strait. | 10,454 |
| Do | Via Panama, Honolulu, and Yokohama | 10,942 |
| Do | Via Suez, Colombo, Singapore, and Hongkong. | 12,660 |
| Sitka, Alaska | Via Panama and San Francisco | 6,369 |
| Do | Via Magellan Strait and San Francisco | 14,389 |
| Sydney, Australia | Via Panama and Tahiti | 9,616 |
| Do | Via St. Vincent, Cape Town, Adelaide, and Melbourne. | 13,802 |
| Valparaiso, Chile | Via Panama Canal | 4,438 |
| Do | Via Magellan Strait | 5,332 |
| Washington, D. C., U. S. A. | Inside Tail of Horseshoe Light-vessel | 173 |
| Do | Outside Tail of Horseshoe Light-vessel | 187 |
| Wellington, New Zealand | Via Panama and Tahiti | 8,656 |
| Do | Via Magellan Strait | 11,296 |
| Do | Via St. Vincent, Cape Town, and Mel- bourne. | 14 500 |
| Wilmington, N. C., U. S. A. .... | ..... | 358 |
| Yokohama, Japan | Via Panama and San Francisco | 9,603 |
| Do | Via Panama and Honolulu | 9,901 |
| Do | Via Suez, Colombo, Singapore, Hong- kong, and Shanghai. | 13,701 |

PAITA

| Paíta, Peru, to— | Route— | Nautical Miles |
|-------------------------------------|--------|----------------|
| Antofagasta, Chile | | 1,299 |
| Apia, Samoa Is. | | 5,365 |
| Arica, Chile | | 1,080 |
| Caldera, Chile | | 1,461 |
| Callao, Peru | | 595 |
| Coquimbo, Chile | | 1,609 |
| Honolulu, Hawaii | | 4,725 |
| Iquique, Chile | | 1,146 |
| Lota, Chile | | 1,983 |
| Mollendo, Peru | | 955 |
| Pascasmayo, Peru | | 201 |
| Pisco, Peru | | 617 |
| Punta Arenas, Chile | | 3,101 |
| Tahiti (Papeete), Society Is. | | 4,082 |
| Talcahuano, Chile | | 1,963 |
| Valdivia (Port Corral), Chile | | 2,141 |
| Valparaiso, Chile | | 1,774 |

PANAMA ROADS

| Panama Roads, Canal Zone, to— | Route— | Nautical Miles |
|---|---|----------------|
| Acapulco, Mexico | | 1,426 |
| Amapala, Honduras | | 745 |
| Antofagasta, Chile | | 2,149 |
| Antwerp, Belgium | Via Mona Passage | 4,851 |
| Apalachicola, Fla., U. S. A. | | 1,330 |
| Apia, Samoa Is. | | 5,710 |
| Arica, Chile | | 1,921 |
| Auckland, New Zealand | | 6,512 |
| Baltimore, Md., U. S. A. | Via Windward and Crooked I. Passages | 1,944 |
| Barbados (Bridgetown), W. I. | | 1,280 |
| Belize, Brit. Honduras | | 859 |
| Bishops Rock (lat. 49° 50' N., long. 6° 27' W.) | Via Anegada Passage | 4,438 |
| Do | Via Mona Passage | 4,399 |
| Blanche Bay, Neu Pommern | | 7,807 |
| Bluefields, Nicaragua | | 319 |
| Bocas del Toro, Panama | | 187 |
| Bombay, India | Via San Bernardino Strait | 12,957 |
| Bordeaux, France | Via Mona Passage | 4,641 |
| Boston, Mass., U. S. A. | Via Windward and Crooked I. Passages and outside Nantucket Lightvessel. | 2,200 |
| Brunswick, Ga., U. S. A. | Via Windward and Crooked I. Passages | 1,593 |
| Calcutta, India | Via San Bernardino Strait | 12,148 |
| Caldera, Chile | | 2,302 |
| Caleta Buena (Buena Cove), Chile | | 1,977 |
| Callao, Peru | | 1,346 |
| Campeche, Mexico | | 1,210 |
| Cape Engano, Luzon I., P. I. | | 8,965 |
| Cape Haitien, Haiti | | 860 |
| Cape San Lucas, Mexico | | 2,100 |
| Carmen, Mexico | | 1,289 |
| Cartagena, Colombia | | 324 |
| Ceiba, Honduras | | 709 |
| Charleston, S. C., U. S. A. | Via Windward and Crooked I. Passages | 1,607 |
| Chimhote, Peru | | 1,158 |
| Christmas I., N. Pacific Ocean | Via St. Thomas, W. I. | 4,752 |
| Cienfuegos, Cuba | | 815 |
| Colombo, Ceylon | Via San Bernardino Strait and Iloilo | 12,087 |
| Coquimbo, Chile | | 2,451 |
| Corinto, Nicaragua | | 683 |
| Coronel, Chile | | 2,822 |
| Curacao (Santa Ana Harbor), W. I. | | 742 |
| Dutch Harbor, Alaska | | 5,245 |
| Enderbury I., Phoenix Is. | | 5,599 |
| Esmeraldas, Ecuador | | 474 |
| Fakarava, Tuamotu Archipelago | | 4,256 |
| Fort De France, Martinique, W. I. | | 1,202 |
| Funafuti I., Ellice Is. | | 6,217 |
| Galapagos Is., San Cristobal I. (Wreck Bay). | | 864 |
| Galveston, Tex., U. S. A. | | 1,536 |
| Gibraltar | Via Anegada Passage | 4,375 |
| Do | Via St. Thomas, W. I. | 4,386 |
| Gracias a Dios, Nicaragua | | 442 |
| Grijalva [Tabasco R.], Mexico | | 1,323 |
| Guam (Port Apra), Marianas | | 7,988 |
| Guantanamo Bay (Caimanera), Cuba | | 739 |
| Guayaquil (Puna), Ecuador | | 793 |
| Guaymas, Mexico | | 2,370 |
| Gulfport, Miss., U. S. A. | Northbound | 1,431 |
| Habana, Cuba | | 1,946 |
| Hakodate, Japan | | 7,418 |
| Halifax, N. S. | Via Windward and Crooked I. Passages | 2,360 |
| Hamburg, Germany | Via Mona Passage, direct | 5,113 |
| Do | Via St. Thomas, W. I. | 5,158 |
| Hampton Roads (off light), Va., U. S. A. | Via Windward and Crooked I. Passages | 1,811 |
| Havre, France | Via Mona Passage | 4,653 |
| Hilo, Hawaii | | 4,527 |
| Hongkong | | 9,195 |
| Honolulu, Hawaii | | 4,685 |
| Iquique, Chile | | 1,987 |
| Iriona, Honduras | | 609 |
| Jacksonville, Fla., U. S. A. | Via Windward and Crooked I. Passages | 1,559 |
| Jaluit, Marshall Is. | | 6,666 |
| Johnson I., Hawaii | | 5,355 |
| Junin, Chile | | 1,967 |

PANAMA ROADS—Continued

| Panama Roads, C. Z., to— | Route— | Nautical Miles |
|--|--|----------------|
| Key West, Fla., U. S. A. | | 1,108 |
| Kingston, Jamaica, W. I. | | 594 |
| Kiska I., Alaska | | 5,819 |
| Kusaie I. (Lollo Hbr.), Caroline Is. | | 7,059 |
| La Guaira, Venezuela | | 884 |
| La Union, Salvador | | 748 |
| Levuka, Fiji Is. | | 6,288 |
| Libertad Anch., Sonora, Mexico | | 2,534 |
| Liverpool, England | Via Mona Passage | 4,591 |
| Livingston, Guatemala | | 815 |
| Los Angeles Hbr. (San Pedro), Cal., U. S. A. | | 2,913 |
| Lota, Chile | | 2,825 |
| Magdalena Bay, Mexico | | 2,265 |
| Manila, P. I. | Via Cape San Lucas and Balingtang Channel | 9,347 |
| Do | Via San Bernardino Strait | 9,370 |
| Marquesa Is., Nakuhiya (Taiohae) | | 3,826 |
| Marshall Is. (Eniwetok Atoll) | | 7,041 |
| Matagorda Bay (Entr.), Tex., U. S. A. | | 1,558 |
| Mazatlan, Mexico | | 2,006 |
| Mejillones Del Sur, Chile | | 2,109 |
| Melbourne, Australia | Via Foveaux Strait | 7,928 |
| Midway Is. (Welles Hbr.) | | 5,707 |
| Mobile, Ala., U. S. A. | Northbound | 1,436 |
| Mollendo, Peru | | 1,796 |
| Monkey Pt. Hbr., Nicaragua | | 302 |
| Montreal, Canada | Via Windward and Crooked I. Passages and Gut of Canso. | 3,203 |
| Naples, Italy | Via Anegada Passage | 5,351 |
| New Hebrides (St. Philip and St. James Bay) | | 6,956 |
| New Orleans, La., U. S. A. | Via South Pass; northbound | 1,446 |
| Do | Via Southwest Pass; northbound | 1,453 |
| New York (The Battery), N. Y. U. S. A. | Via Windward and Crooked I. Passages | 2,017 |
| Newport News, Va., U. S. A. | do. | 1,819 |
| Nonuti I., Gilbert Is. | | 6,439 |
| Norfolk, Va., U. S. A. | Via Windward and Crooked I. Passages | 1,822 |
| Noumea, New Caledonia | | 6,982 |
| Nukonono, Union Is. | | 5,688 |
| Pacasmayo, Peru | | 1,040 |
| Pago Pago, Samoa Is. | | 5,656 |
| Païta, Peru | | 857 |
| Pelew Is. (Korror Hbr.) | | 8,674 |
| Pensacola, Fla., U. S. A. | Northbound | 1,412 |
| Philadelphia, Pa., U. S. A. | Via Windward and Crooked I. Passages | 1,989 |
| Pisagua, Chile | | 1,962 |
| Pisco, Peru | | 1,458 |
| Plymouth, England | Via St. Thomas, W. I. | 4,543 |
| Point a Pitre, Guadeloupe, W. I. | | 1,211 |
| Ponape, Caroline Is. | | 7,321 |
| Port Arthur, Tex., U. S. A. | | 1,528 |
| Port au Prince, Haiti | | 817 |
| Port Castries, S. Lucia, W. I. | | 1,203 |
| Port Limon, Costa Rica | | 235 |
| Port Lloyd, Ogasawara Is. | | 7,766 |
| Port Morelos, Yucatan | | 871 |
| Port Royal, Jamaica, W. I. | | 589 |
| Port of Spain, Trinidad, W. I. | | 1,202 |
| Port Taital, Chile | | 2,225 |
| Port Tampa, Fla., U. S. A. | | 1,255 |
| Port Townsend, Wash., U. S. A. | | 3,985 |
| Portland, Me., U. S. A. | Via Windward and Crooked I. Passages; outside Nantucket Lightvessel. | 2,241 |
| Portland, Ore., U. S. A. | | 3,869 |
| Puerto Barrios, Guatemala | | 823 |
| Puerto Cabello, Venezuela | | 845 |
| Puerto Cortes, Honduras | | 776 |
| Puerto Mexico, Mexico | | 1,420 |
| Punta Arenas, Chile | | 3,943 |
| Punta Arenas, Costa Rica | | 471 |
| Quebec, Canada | Via Windward and Crooked I. Passages and Gut of Canso. | 3,965 |
| Raoul I. (East Anch.), Kermadec Is. | | 6,125 |
| Rarotonga I. (Avarua Hbr.) | | 5,095 |
| Rio de Janeiro, Brazil | | 4,392 |

PANAMA ROADS—Continued

| Panama Roads, C. Z., to— | Route— | Nautical Miles |
|--|--------------------------------------|----------------|
| Rio Grande (Entr.) | | 1,527 |
| Roatan I. (Coxen Hole) | | 684 |
| Sabine, Tex., U. S. A. | | 1,519 |
| St. Thomas, W. I. | | 1,072 |
| Salina Cruz, Mexico | | 1,170 |
| San Bernardino Strait (Entr.), P. I. | | 9,060 |
| San Blas, Mexico | | 1,914 |
| San Diego, Cal., U. S. A. | | 2,843 |
| San Francisco, Cal., U. S. A. | | 3,245 |
| San Jose, Guatemala | | 886 |
| San Juan, P. R. | | 1,036 |
| San Juan del Norte, Nicaragua | | 289 |
| San Juan del Sur, Nicaragua | | 590 |
| Santa Barbara, Cal., U. S. A. | | 2,980 |
| Santo Domingo, Dominican Rep. | | 845 |
| Savannah, Ga., U. S. A. | Via Windward and Crooked I. Passages | 1,606 |
| Seattle, Wash., U. S. A. | | 4,021 |
| Shanghai, China | Via Honolulu | 9,015 |
| Do | Via Osumi (Van Diemen) Strait | 8,650 |
| Do | Via Tsugaru Strait | 8,556 |
| Singapore, Straits Settlements | Via San Bernardino Strait | 10,505 |
| Southport, N. C., U. S. A. | Via Windward and Crooked I. Passages | 1,635 |
| Strait of Gibraltar (lat. 35° 57' N., long. 5° 45' W.) | Via Anegada Passage | 4,351 |
| Sydney, Australia | | 7,374 |
| Tacoma, Wash., U. S. A. | | 4,041 |
| Tahiti (Papeete), Society Is. | | 4,186 |
| Talcahuano, Chile | | 2,805 |
| Tampico, Mexico | | 1,528 |
| Tela, Honduras | | 719 |
| Tocopilla, Chile | | 2,068 |
| Tongatabu (Nukualofa), Tonga Is. | | 5,953 |
| Trujillo, Honduras | | 665 |
| Tuxpam, Mexico | | 1,498 |
| Ugi I. (Selwyn Bay), Solomon Is. | | 7,248 |
| Uracas I., Marianas | | 7,797 |
| Valdivia (P. Corral), Chile | | 2,983 |
| Valparaiso, Chile | | 2,616 |
| Vancouver, B. C. | | 4,032 |
| Vera Cruz, Mexico | | 1,463 |
| Vladivostok, Siberia | Via Tsugaru Strait | 7,833 |
| Wellington, New Zealand | | 6,595 |
| Yap I. (Tomill Hbr.), Caroline Is. | | 8,430 |
| Yokohama, Japan | Via Cape San Lucas and G. C. | 7,682 |
| Do | Via Mazatlan | 7,788 |
| Do | Via San Francisco | 7,781 |

PORT TOWNSEND

| Port Townsend, Wash., U. S. A. to— | Route— | Nautical Miles |
|------------------------------------|---|----------------|
| Amoy, China | Via Tsugaru Strait and Composite route. | 5,450 |
| Do | Via Osumi (Van Diemen) Strait and Composite route. | 5,477 |
| Do | Via Unimak Passage and Tsugaru St. | 5,442 |
| Do | Via Unimak Passage, Amphitrite Sts. and La Perouse. | 5,434 |
| Antwerp, Belgium | Via San Francisco and Panama Canal | 8,866 |
| Do | Via San Francisco and Magellan St. | 14,391 |
| Apia, Samoa Is. | | 4,577 |
| Auckland, New Zealand | | 6,134 |
| Baltimore, Maryland, U. S. A. | Via San Francisco and Panama Canal | 5,959 |
| Do | Via San Francisco and Magellan St. | 13,979 |
| Batavia, Java | Via Balintang Channel and Composite route. | 7,323 |
| Blanche Bay, Neu Pommern | | 5,462 |
| Bordeaux, France | Via San Francisco and Panama Canal | 8,656 |
| Do | Via San Francisco and Magellan St. | 14,032 |
| Boston, Mass., U. S. A. | Via San Francisco and Panama Canal | 6,215 |
| Do | Via San Francisco and Magellan St. | 13,876 |
| Calcutta, India | Via Rhumb to Yokohama | 8,970 |
| Canton, China | Via Osumi (Van Diemen) Strait and Composite route. | 5,814 |
| Do | Via Tsugaru St. and Composite route | 5,792 |
| Do | Via Unimak Passage and Tsugaru St. | 5,764 |

PORT TOWNSEND—Continued

| Port Townsend, Wash., U. S. A. to— | Route— | Nautical Miles |
|--|--|----------------|
| Cape Ergano, Luzon L., P. I. .... | ..... | 5,515 |
| Cebu, Cebu Island, P. I. .... | ..... | 5,870 |
| Charleston, S. C., U. S. A. | Via San Francisco and Panama Canal | 5,822 |
| Do | Via San Francisco and Magellan St. | 13,856 |
| Chefoo, China | Via Tsugaru St. and Composite route | 5,102 |
| Do | Via Unimak Passage and Tsugaru St. | 5,074 |
| Do | Via Osumi (Van Diemen) Strait | 5,340 |
| Do | Via Unimak Passage, Amphitrite and La Perouse. | 5,084 |
| Christmas Island, N. Pacific Ocean | ..... | 3,344 |
| Colombo, Ceylon | Via Balintang Channel, Malakka Sts. and Composite route. | 3,616 |
| Comox, B. C. | Via Active Passage | 145 |
| Dutch Harbor, Unalaska I., Alaska | ..... | 1,670 |
| Enderbury I., Phoenix Is. .... | ..... | 4,012 |
| Fakarava I., Tuamotu Archipelago | ..... | 4,120 |
| Foochow, China | Via Osumi (Van Diemen) Strait and Composite route. | 5,364 |
| Do | Via Tsugaru St. and Composite route | 5,328 |
| Do | Via Unimak Passage and Tsugaru St. | 5,300 |
| Do | Via Unimak Passage, Amphitrite Sts. and La Perouse. | 5,313 |
| Funafuti I., Ellice Is. .... | ..... | 4,692 |
| Galapagos Is., San Cristobol I. .... | ..... | 3,734 |
| (Wreck Bay.) | ..... |  |
| Galveston, Texas | Via San Francisco and Panama Canal | 5,551 |
| Do | Via San Francisco and Magellan St. | 14,497 |
| Gibraltar | Via San Francisco, Panama Canal and Anegada Passage. | 8,390 |
| Do | Via San Francisco and Magellan St. | 13,341 |
| Guam (Port Apra) Marianas | ..... | 4,913 |
| Hakodate, Japan | Composite | 3,915 |
| Do | Via Unimak Passage | 3,887 |
| Hamburg, Germany | Via San Francisco, Panama and Mona Passage. | 9,128 |
| Do | Via San Francisco and Magellan St. | 14,653 |
| Hongkong | Via Osumi (Van Diemen) St. and Composite route. | 5,731 |
| Do | Via Rhumb to Yokohama | 5,992 |
| Do | Via Tsugaru Strait and Composite | 5,709 |
| Do | Via Unimak Passage and Tsugaru St. | 5,681 |
| Honolulu, Hawaii | ..... | 2,366 |
| Iloilo, P. I. .... | ..... | 5,892 |
| Jacksonville, Florida, U. S. A. | Via San Francisco and Panama Canal | 5,574 |
| Do | Via San Francisco and Magellan St. | 13,875 |
| Jaluit, Marshall Is. .... | ..... | 4,259 |
| Jinsen (Chemulpo), | Via Unimak Passage, Amphitrite Sts. and La Perouse. | 4,977 |
| Do | Via Unimak Passage and Tsugaru St. | 4,967 |
| Do | Via Tsugaru St. and Composite route. | 4,995 |
| Do | Via Osumi (Van Diemen) Strait | 5,242 |
| Johnson Island, Hawaii | ..... | 2,978 |
| Kiska I. (Kiska Hbr.), Alaska | Via Unimak Passage | 2,257 |
| Kobe, Japan | Composite | 4,500 |
| Kodiak, Alaska | ..... | 1,229 |
| Kusale I. (Lollo Hbr.), Caroline Is. | ..... | 4,542 |
| Levuka, Fiji Is. | ..... | 5,083 |
| Liverpool, England | Via San Francisco and Panama Canal | 8,606 |
| Do | Via San Francisco and Magellan St. | 14,272 |
| Manila, P. I. | Composite Great Circle | 5,931 |
| Marquesas Is., Nukuhiva (Taiohae) | ..... | 3,628 |
| Marshall Islands (Eniwetok Atoll) | ..... | 4,315 |
| Mobile, Alabama, U. S. A. | Via San Francisco and Panama Canal | 5,429 |
| Do | Via San Francisco and Magellan St. | 14,268 |
| Nagasaki, Japan | Via Tsugaru St. and Composite | 4,700 |
| Do | Via Osumi (Van Diemen) St. and Composite. | 4,832 |
| New Hebrides (St. Philip and St. James Bay.) | ..... | 5,344 |
| New Orleans, La., U. S. A. | Via San Francisco, Panama and South-west Pass. | 5,457 |
| Do | Via San Francisco, Magellan St. and South Pass. | 14,321 |
| New York, N. Y., U. S. A. | Via Panama Canal | 6,002 |
| Do | Via Magellan St. | 13,872 |
| Nonuti Island, Gilbert Islands | ..... | 4,395 |

PORT TOWNSEND—Continued

| Port Townsend, Wash., U.S.A., to— | Route | Nautical Miles |
|--|--|----------------|
| Norfolk, Va., U. S. A. | Via San Francisco and Panama Canal | 5,837 |
| Do | Via San Francisco and Magellan St. | 13,857 |
| Noumea, New Caledonia ..... | ..... | 5,729 |
| Nukonono, Union Is. .... | ..... | 4,345 |
| Panama Road, C. Z. .... | ..... | 3,985 |
| Pelew Is. (Korror Hbr.) ..... | ..... | 5,537 |
| Pensacola, Florida, U. S. A. | Via San Francisco and Panama | 5,402 |
| Do | Via San Francisco and Magellan St. | 14,238 |
| Petropavlovsk, Kamchatka | Via Unimak Passage | 2,905 |
| Philadelphia, Pa., U. S. A. | Via San Francisco and Panama Canal | 6,004 |
| Do | San Francisco and Magellan St. | 13,952 |
| Port Lloyd, Ogasawara Is. .... | ..... | 4,416 |
| Port Tampa, Florida, U. S. A. | Via San Francisco and Panama Canal | 5,270 |
| Do | Via San Francisco and Magellan St. | 14,023 |
| Portland, Maine, U. S. A. | Via San Francisco and Panama Canal | 6,256 |
| Do | Via San Francisco and Magellan St. | 13,907 |
| Punta Arenas, Chile ..... | ..... | 6,931 |
| Raoul Island (East Anch.), Kermadec Islands. | ..... | 5,547 |
| Rarotonga I. (Avarua Hbr.), Cook Is. .... | ..... | 4,665 |
| Ryojun (Port Arthur), Kwangtung, Manchuria. | Via Tsugaru St. and Composite route | 5,143 |
| Do | Via Unimak Passage and Tsugaru St. | 5,115 |
| Do | Via Unimak Passage, Amphitrite Sts. and La Perouse. | 5,125 |
| Do | Via Osumi (Van Diemen) St. | 5,381 |
| San Bernardino Strait (Entr.), P. I. .... | ..... | 5,714 |
| San Francisco, Cal., U. S. A. .... | ..... | 770 |
| Savannah, Georgia, U. S. A. | Via San Francisco and Panama Canal | 5,621 |
| Do | Via San Francisco and Magellan St. | 12,888 |
| Seattle, Wash. .... | ..... | 28 |
| Shanghai, China | Via Unimak Passage, Amphitrite Sts. and La Perouse. | 5,035 |
| Do | Via Osumi (Van Diemen) St. and Composite. | 5,186 |
| Do | Via Tsugaru St. and Composite | 5,953 |
| Do | Via Unimak Passage and Tsugaru St. | 5,025 |
| Shimonoseki, Japan | Via Composite route from Yokohama and Bungo Channel. | 4,689 |
| Do | Via Tsugaru St. and Composite route | 4,583 |
| Singapore, Straits Settlements | Via Composite route and Balintang Channel. | 7,034 |
| Sitka, Alaska | Via Juan de Fuca Strait and outside | 772 |
| Swatow, China | Via Composite route and Osumi (Van Diemen) St. | 5,581 |
| Do | Via Composite route and Tsugaru St. | 5,559 |
| Do | Via Unimak Passage and Tsugaru St. | 5,531 |
| Tahiti (Papeete), Society Islands ..... | ..... | 4,260 |
| Taku, China | Via Unimak Passage, Amphitrite Sts. and La Perouse. | 5,278 |
| Do | Via Osumi (Van Diemen) St. | 5,534 |
| Do | Via Composite route and Tsugaru St. | 5,296 |
| Do | Via Unimak Passage and Tsugaru St. | 5,268 |
| Tansui Harbor, Taiwan (Formosa) | Via Unimak Passage, Amphitrite St. and La Perouse. | 5,272 |
| Do | Via Osumi (Van Diemen) St. and Composite. | 5,292 |
| Do | Via Composite and Tsugaru St. | 5,233 |
| Do | Via Unimak Passage and Tsugaru St. | 5,255 |
| Ugi I. (Selwyn Bay), Solomon Is. .... | ..... | 5,310 |
| Uracas I., Marianas ..... | ..... | 4,585 |
| Vancouver, B. C. .... | ..... | 35 |
| Victoria, Vancouver Island, B. C. .... | ..... | 35 |
| Vladivostok, Siberia | Via Akutan Passage and Tsugaru St. | 4,300 |
| Do | Via Unimak Passage, Amphitrite Sts. and La Perouse. | 4,183 |
| Do | Via Composite route and Tsugaru St. | 4,330 |
| Do | Via Unimak Passage and Tsugaru St. | 4,302 |
| Weihaiwei, China | Via Unimak Passage and Tsugaru St. and La Perouse. | 5,050 |
| Do | Via Osumi (Van Diemen) St. | 5,306 |
| Do | Via Composite route and Tsugaru St. | 5,063 |
| Do | Via Unimak Passage and Tsugaru St. | 5,040 |
| Yap I. (Tomill Hbr.), Caroline Is. .... | ..... | 5,346 |
| Yokohama, Japan | Composite; south of Aleutian Islands | 4,218 |
| Do | Via Rhumb | 4,469 |

SAN DIEGO

| San Diego, Cal., U. S. A., to— | Route— | Nautical Miles |
|------------------------------------|--------|-------------------|
| Acapulco, Mexico | | 1,431 |
| Antofagasta, Chile | | 4,360 |
| Arica, Chile | | 4,149 |
| Caldera, Chile | | 4,492 |
| Callao, Peru | | 3,585 |
| Chimbote, Peru | | 3,402 |
| Cequimbo, Chile | | 4,605 |
| Corinto, Nicaragua | | 2,211 |
| Esmeraldas, Ecuador | | 2,940 |
| Guayaquil (Puna), Ecuador | | 3,112 |
| Guaymas, Mexico | | 1,088 |
| Hilo, Hawaii | | 2,175 |
| Iquique, Chile | | 4,218 |
| Los Angeles Harbor, Cal., U. S. A. | | 92 |
| Lota, Chile | | 4,881 |
| Magdalena Bay, Mexico | | 600 |
| Mazatlan, Mexico | | 939 |
| Midway Is. (Welles Harbor) | | 3,097 |
| Mollendo, Peru | | 4,024 |
| Pacasmayo, Peru | | 3,286 |
| Paita, Peru | | 3,121 |
| Panama, C. Z. | | 2,843 |
| Pisco, Peru | | 3,695 |
| Portland, Ore., U. S. A. | | 1,073 |
| Punta Arenas, Chile | | 5,801 |
| Punta Arenas, Costa Rica | | 2,429 |
| Salina Cruz, Mexico | | 1,753 |
| San Blas, Mexico | | 1,015 |
| San Jose, Guatemala | | 1,993 |
| Talcahuano, Chile | | 4,869 |
| Valdivia (Port Corral), Chile | | 5,007 |
| Valparaiso, Chile | | 4,738 |

SAN FRANCISCO

| San Francisco, Cal., U. S. A., to— | Route— | Nautical Miles |
|--|-----------------------------------|-------------------|
| Acapulco, Mexico | | 1,883 |
| Amapala, Honduras | | 2,586 |
| Amoy, China | Via Osumi (Van Dieman) Strait | 5,796 |
| Anchorage, Cook Inlet, Alaska | | 1,872 |
| Antofagasta, Chile | | 4,762 |
| Antwerp, Belgium | Via Panama Canal | 8,096 |
| Apia, Samoa Is. | | 4,161 |
| Arica, Chile | | 4,551 |
| Auckland, New Zealand | | 5,680 |
| Baltimore, Md., U. S. A. | Via Panama Canal | 5,189 |
| Batavia, Java | Via Balintang Channel | 7,642 |
| Bishop's Rock (lat. 49° 50' N., long. 6° 27' W.) | Via Panama Canal and Mona Passage | 7,644 |
| Blanche Bay, New Pommern | | 5,396 |
| Bordeaux, France | Via Panama Canal | 7,886 |
| Do | Via Magellan Strait | 13,262 |
| Boston, Mass., U. S. A. | Via Panama Canal | 5,445 |
| Bremen, Germany | do. | 8,323 |
| Bremerton, Wash. | | 81 |

SAN FRANCISCO—Continued

| San Francisco, Cal., U. S. A., to— | Route | Nautical Miles |
|---|---|-------------------|
| Brest, France | Via Magellan and Rio de Janeiro | 13,271 |
| Do | Via Panama and Mona Passage | 7,708 |
| Buenos Aires | Via Panama Canal | 8,738 |
| Do | Via Magellan Strait | 7,576 |
| Caldera, Chile | | 4,894 |
| Caleta Buena (Buena Cove), Chile | | 4,608 |
| Callao, Peru | | 3,987 |
| Canton, China | Via Osumi (Van Diemen) Strait | 6,132 |
| Cape Ergano, Luzon I., P. I. | | 5,840 |
| Cape Wrangell, Attu I., Alaska | | 2,798 |
| Cebu, Cebu Island, P. I. | | 6,146 |
| Charleston, S. C., U. S. A. | Via Panama Canal | 4,852 |
| Chefoo, China | Via Tsugaru Strait | 5,436 |
| Do | Via Osumi (Van Diemen) Strait | 5,659 |
| Chimbote, Peru | | 3,804 |
| Christmas Island, N. Pacific Ocean | | 2,894 |
| Colombo, Ceylon | Via Balintang Channel and Malakka Strait. | 8,935 |
| Copenhagen, Denmark | Via Panama and Mona Passage | 8,638 |
| Coquimbo, Chile | | 5,007 |
| Corinto, Nicaragua | | 2,613 |
| Dutch Harbor, Alaska | Via Sitka | 2,386 |
| Enderbury I., Phoenix Is. | | 3,657 |
| Esmeraldas, Ecuador | | 3,342 |
| Fakarava I., Tuamotu Archipelago | | 3,503 |
| Flavel, Oregon | | 561 |
| Foochow, China | Via Osumi (Van Diemen) Strait | 5,683 |
| Funafuti I., Ellice Is. | | 4,295 |
| Galapagos Is., San Cristobal I., (Wreck Bay.) | | 2,994 |
| Galveston, Texas | Via Panama Canal | 4,781 |
| Do | Via Magellan Strait | 13,727 |
| Gibraltar | Via Panama Canal and Anegada Passage. | 7,620 |
| Guam (Port Apra) Marianas | | 5,053 |
| Guayaquil (Puna) Ecuador | | 3,514 |
| Guaymas, Mexico | | 1,490 |
| Gulf of Fonseca (Moneypenny Pt.), Nicaragua. | | 2,587 |
| Habana, Cuba | Via Panama Canal | 4,291 |
| Hakodate, Japan | | 4,249 |
| Halifax, N. S. | Via Panama Canal | 5,605 |
| Hamburg, Germany | Via Panama Canal | 8,358 |
| Havre, France | do | 7,898 |
| Hongkong | | 6,306 |
| Honolulu, Hawaii | | 2,091 |
| Iloilo, P. I. | | 6,168 |
| Iquique, Chile | | 4,620 |
| Jacksonville, Fla. | Via Panama Canal | 4,804 |
| Jaluit, Marshall Is. | | 4,150 |
| Jinsen (Chemulpo), Chosen (Korea) | Via Osumi (Van Diemen) Strait | 5,561 |
| Johnson Island, Hawaii | | 2,779 |
| Junin, Chile | | 4,598 |
| Key West, Fla. | Via Panama Canal | 4,353 |
| Kiska I., Alaska | | 2,629 |
| Kusaie I., (Lollo), Caroline Is. | | 4,478 |
| La Union, Salvador | | 2,586 |
| Levuka, Fiji Is. | | 4,705 |
| Libertad Anch., Sonora, Mexico | | 1,648 |
| Liverpool, England | Via Panama Canal | 7,836 |
| Do | Via Magellan Strait | 13,502 |

SAN FRANCISCO—Continued

| San Francisco, Cal., U. S. A., to— | Route | Nautical Miles |
|---|--|----------------|
| London, England | Via Panama Canal and Mona Passage | 8,051 |
| Los Angeles Harbor (San Pedro) | | 368 |
| Lota, Chile | | 5,282 |
| Magdalena Bay, Mexico | | 1,002 |
| Manila, P. I. | Via Balintang Channel | 6,221 |
| Do | Via San Bernardino Strait | 6,301 |
| Do | Via Honolulu and north end of Luzon, P. I. | 6,960 |
| Do | Via Honolulu, Guam and north end of Luzon, P. I. | 7,170 |
| Do | Via Honolulu, Guam and San Bernardino Strait | 6,929 |
| Do | Via Honolulu, Yokohama and Balintang Channel | 7,242 |
| Do | Via Yokohama and Balintang Channel | 6,293 |
| Do | Via Yokohama, Osumi (Van Diemen) Strait and Hongkong | 6,752 |
| Do | Via Yokohama, Inland Sea, and Nagasaki | 6,575 |
| Do | Via Yokohama, Osumi (Van Diemen) Strait and Nagasaki | 6,522 |
| Do | Via Osumi (Van Diemen) Strait and Nagasaki | 6,457 |
| Mare I., (Navy Yard), Cal., U. S. A. | | 23 |
| Muquesas Is., Nukuhiva (Taiohae) | | 2,987 |
| Marshal Islands (Eniwetok Atoll) | | 4,306 |
| Mazatlan, Mexico | | 1,337 |
| Mejillones del Sur, Chile | | 4,734 |
| Midway Is., (Welles Hrabor) | | 2,792 |
| Mobile, Alabama, U. S. A. | Via Panama Canal | 4,659 |
| Do | Via Magellan Strait | 13,498 |
| Mollendo, Peru | | 4,426 |
| Monterey, Cal., U. S. A. | | 95 |
| Nagasaki, Japan | Via Yokohama and Inland Sea | 5,269 |
| Naples, Italy | Via Panama Canal | 8,596 |
| New Hebrides (St. Philip and St. James Bay) | | 5,086 |
| New Orleans, La., U. S. A. | Via Panama Canal and South Pass | 4,691 |
| Do | Via Panama Canal and Southwest Pass | 4,698 |
| New York (The Battery), N. Y., U. S. A. | Via Cape Horn | 13,328 |
| Do | Via Magellan Strait | 13,135 |
| Do | Via Panama Canal | 5,262 |
| Newcastle, Australia | | 6,467 |
| Newport News, Va., U. S. A. | Via Panama Canal | 5,064 |
| Nonuti Island, Gilbert Islands | | 4,185 |
| Norfolk Va., U. S. A. | Via Panama Canal | 5,067 |
| Noumea, New Caledonia | | 5,410 |
| Nukonono, Union Is. | | 3,957 |
| Pacasmayo, Peru | | 3,688 |
| Pago Pago, Samoa Is. | | 4,150 |
| Païta, Peru | | 3,523 |
| Panama, C. Z. | | 3,245 |
| Paramaribo, Guiana | Via Panama Canal | 4,936 |
| Pelew Is. (Korror Hbr.) | | 5,751 |
| Pensacola, Fla., U. S. A. | Via Panama Canal | 4,632 |
| Do | Via Magellan Strait | 13,458 |
| Petrovsk, Kamchatka | Via Unimak Passage | 3,292 |
| Philadelphia, Pa., U. S. A. | Via Panama Canal | 5,234 |
| Pichilique, Mexico | | 1,300 |
| Pisagua, Chile | | 4,593 |
| Pisco, Peru | | 4,097 |
| Plymouth, England | Via Panama and Mona Passage | 7,788 |
| Pola, Austria | Via Panama and Anegada Passage | 9,255 |
| Do | Via Magellan Strait and Rio de Janeiro | 14,323 |
| Ponape, Caroline Is. | | 4,641 |
| Port Lloyd, Ogasawara Is. | | 4,675 |
| Port Taitai, Chile | | 4,838 |
| Port Tampa, Fla., U. S. A. | Via Panama Canal | 4,590 |
| Do | Via Magellan Strait | 13,253 |
| Portsmouth, England | Via Panama Canal | 7,875 |
| Do | Via Magellan Strait and Rio de Janeiro | 13,471 |

SAN FRANCISCO—Continued

| San Francisco, Cal., U. S. A., to— | Route | Nautical Miles |
|--|---|----------------|
| Port Townsend, Wash., U. S. A. .... | ..... | 770 |
| Portland, Maine, U. S. A. | Via Panama Canal | 5,486 |
| Portland, Oregon, U. S. A. .... | ..... | 650 |
| Punta Arenas, Chile ..... | ..... | 6,193 |
| Punta Arenas, Costa Rica ..... | ..... | 2,831 |
| Raoul Island, (East Anch.), Kermadec Islands. .... | ..... | 5,090 |
| Rarotonga I., (Avarua Hbr.), Cook Is. .... | ..... | 4,124 |
| Rio de Janeiro, Brazil | Via Panama Canal | 7,637 |
| Do | Via Magellan Strait | 8,430 |
| Ryojun (Port Arthur), Kwangtung, Manchuria. | Via Osumi (Van Diemen) Strait | 5,700 |
| St. Paul, Pribilof Is., Alaska | Via Dutch Harbor | 2,289 |
| Salina Cruz, Mexico ..... | ..... | 2,135 |
| San Bernardino Strait (Entr.), P. I. .... | ..... | 5,991 |
| San Blas, Mexico ..... | ..... | 1,417 |
| San Diego, Cal., U. S. A. .... | ..... | 452 |
| San Jose, Guatamala ..... | ..... | 2,395 |
| San Juan, P. R. | Via Panama Canal | 4,281 |
| Santa Barbara, Cal., U. S. A. .... | ..... | 288 |
| Sasebo, Japan | Via Osumi (Van Diemen) Strait | 5,185 |
| Savannah, Georgia, U. S. A. | Via Panama Canal | 4,851 |
| Seattle, Wash., U. S. A. .... | ..... | 804 |
| Sevastopol, Russia | Via Panama and Aneгада Passage | 9,738 |
| Shanghai, China | Via Osumi (Van Diemen) Strait | 5,505 |
| Shimonoseki, Japan | Via Bungo Channel and Osumi (Van Diemen) Strait | 5,008 |
| Do | Via Tsugaru Strait | 4,916 |
| Singapore, Straits Settlement | Via Balintang Channel | 7,353 |
| Sitka, Alaska ..... | ..... | 1,302 |
| Southampton, England | Via Panama Canal | 7,863 |
| Spezia, Italy | Via Panama and Aneгада Passage | 8,496 |
| Do | Via Magellan Strait and Rio de Janeiro | 13,564 |
| Stockholm, Sweden | Via Panama Canal | 9,185 |
| Swatow, China | Via Osumi (Van Diemen) Strait | 5,900 |
| Sydney, Australia | Via Honolulu, Pago Pago, and Auckland. | 7,212 |
| Do | Via Honolulu and Pago Pago | 6,744 |
| Tacoma, Wash., U. S. A. .... | ..... | 826 |
| Taku, China | Via Osumi (Van Diemen) Strait | 5,853 |
| Do | Via Tsugaru Strait | 5,630 |
| Talcahuano, Chile ..... | ..... | 5,270 |
| Tamsui Harbor, Taiwan (Formosa) .. | Via Osumi (Van Diemen) Strait | 5,611 |
| Do | Via Tsugaru Strait | 5,617 |
| Tientsin, China | Via Yokohama, Bungo Channel and north of Quelpart I. | 5,918 |
| Tocopilla, Chile ..... | ..... | 4,699 |
| Tongatabu (Nukualofa) Tonga Is. .... | ..... | 4,628 |
| Ugi I., (Selwyn Bay), Solomon Is. .... | ..... | 5,129 |
| Uracas I., Marianas ..... | ..... | 4,779 |
| Valdivia (Port Corral), Chile ..... | ..... | 5,407 |
| Valparaiso, Chile ..... | ..... | 5,140 |
| Vera Cruz, Mexico | Via Panama | 4,798 |
| Vladivostok, Siberia | Via Unimak Passage, Amphitrite St. | 4,570 |
| Do | Tsugaru Strait | 4,664 |
| Weihaiwei, China | Via Tsugaru Strait | 5,402 |
| Do | Via Osumi (Van Diemen) Strait | 5,625 |
| Wellington, New Zealand ..... | ..... | 5,905 |
| Wielmshaven, Germany | Via Panama and Mona Passage | 8,294 |
| Do | Via Magellan and Rio de Janeiro | 13,883 |
| Wilmington, N. C., U. S. A. | Via Panama Canal | 4,901 |
| Yap I. (Tomli Hbr.), Caroline Is. .... | ..... | 5,501 |
| Yokohama, Japan | Great Circle | 4,536 |
| Do | Rhumb | 4,799 |

SAN FRANCISCO

DISTANCES FROM SAN FRANCISCO, CAL., U. S. A., TO DOMESTIC, MEXICAN
AND BRITISH COLUMBIA PORTS AND COAST POINTS

| | Nautical Miles | | Nautical Miles |
|------------------------------|-------------------|-----------------------------------|-------------------|
| Anacortes, Wash. | 796 | Olympia, Wash. | 862 |
| Anchorage, Alaska | 1872 | Pigeon Point | 45 |
| Astoria, Oregon | 555 | Pillar Point | 26 |
| Bellingham, Wash. | 810 | Point Arena | 100 |
| Bodega Head | 51 | Point Arguello | 252 |
| Bolinas | 16 | Point Bonita | 7 |
| Bremerton, Wash. | 815 | Point Buchon | 206 |
| Cape Arago | 372 | Point Conception | 263 |
| Cape Blanco | 341 | Point Cypress | 100 |
| Cape Disappointment | 545 | Point Duma | 367 |
| Cape Flattery, Wash. | 680 | Point Fermin | 391 |
| Cape Fortuna | 200 | Point Gorda | 184 |
| Cape Foulweather | 464 | Point Lobos | 7½ |
| Cape Lookout | 486 | Point Loma | 475 |
| Cape Mendocino | 195 | Point New Year | 50 |
| Cape Perpetua | 423 | Point Pedro | 19 |
| Cape San Martin | 147 | Point Piedras Blancas | 166 |
| Cape St. George | 276 | Point Reyes | 33 |
| Carpenteria | 312 | Point Sal | 232 |
| Cayucos | 193 | Point San Luis | 115 |
| Columbia River Bar | 540 | Point Sur | 115 |
| Coos Bay | 375 | Point Tomales | 46 |
| Coquille River | 360 | Point Vincent | 384 |
| Crescent City | 274 | Port Clarence | 2723 |
| Destruction Island | 634 | Portland, Oregon | 650 |
| Douglas Island | 1593 | Port Orford | 336 |
| Dutch Harbor | 2051 | Port San Luis | 216 |
| Dutch Harbor via Sitka | 2336 | Port Townsend | 770 |
| Onsenada | 496 | Powell River, B. C. | 868 |
| Eureka (Humboldt Bay) | 216 | Redondo | 379 |
| Everett, Wash. | 797 | Rogue River | 313 |
| False Tillamook | 511 | San Diego | 482 |
| Flattery Rocks | 667 | San Jose del Cabo | 1192 |
| Flavel, Oregon | 561 | San Luis Obispo | 226 |
| Gaviota | 275 | San Simeon | 172 |
| Goleta | 296 | Santa Barbara | 288 |
| Grays Harbor | 558 | Santa Cruz | 71 |
| Guaymas, Mexico | 1490 | Santa Monica | 372 |
| Hueneme | 337 | San Pedro | 393 |
| Humboldt Bay | 216 | Santa Rosalia | 1835 |
| Juneau, Alaska | 1596 | Seattle, Wash. | 864 |
| Killisnoo | 1299 | Shelter Cove | 165 |
| Kiska Island, Alaska | 2629 | Shoalwater Bay | 569 |
| Klawak | 1472 | Sitka, Alaska | 1302 |
| Kotzebue Sound | 2927 | St. Michael | 2705 |
| Ladysmith, B. C. | 804 | Table Bluff | 212 |
| La Paz | 1722 | Tacoma, Wash. | 826 |
| Lompoc Landing | 241 | Tillamook Bay | 499 |
| Loring | 1381 | Tillamook Head | 523 |
| Los Angeles Harbor | 368 | Trinidad | 233 |
| Magdalena Bay | 1002 | Umpqua River | 394 |
| Mazatlan | 1478 | Unalaska | 2051 |
| Mendocino | 123 | Union Bay, B. C. | 875 |
| Monterey | 93 | Vancouver, B. C. | 833 |
| Moro Bay | 198 | Ventura | 327 |
| Nanaimo, B. C. | 828 | Victoria, B. C. | 750 |
| Newport | 411 | Willapa Hbr. "Whistle Buoy" | 588 |
| New Westminster, B. C. | 829 | Wrangel, Alaska | 1448 |
| Nome, Alaska | 2705 | Yakuina Bay | 454 |

WILLAPA HARBOR

| Willapa Harbor Wash. "Whistle Buoy" to— | Route— | Nautical Miles |
|--|--------------------|-------------------|
| Astoria, Oregon | | 38 |
| Eureka, Humboldt Bay | | 355 |
| Grays Harbor, "Whistle Buoy" | | 15½ |
| Honolulu, Hawaii | | 2,268 |
| Los Angeles Harbor (San Pedro) | | 956 |
| Cal. | | |
| Manila, P. I. | Via Honolulu | 7,035 |
| Port Townsend, Wash. | | 194 |
| San Francisco | | 588 |
| Seattle, Wash. | | 233 |
| Tacoma, Wash. | | 258 |
| Vancouver, B. C. | | 254 |
| Victoria, B. C. | | 179 |

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